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United States Patent [19]

Jahn

[11] **Patent Number: 4,706,601**

[45] **Date of Patent: Nov. 17, 1987**

[54] **DEVICE FOR APPLYING MEDIUM AFTER TERMINATION OF THE PRINTING OPERATION IN A PRINTING MACHINE**

[75] Inventor: **Hans-Georg Jahn,** Wiesenbach, Fed. Rep. of Germany

[73] Assignee: **Heidelberger Druckmaschinen AG,** Heidelberg, Fed. Rep. of Germany

[21] Appl. No.: **735,954**

[22] Filed: **May 20, 1985**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 626,732, Jul. 2, 1984, abandoned.

[30] **Foreign Application Priority Data**

Jul. 5, 1983 [DE] Fed. Rep. of Germany 3324096

[51] **Int. Cl.**[4] **B05C 1/02; B05C 11/10**

[52] **U.S. Cl.** **118/46;** 118/211; 118/236; 118/249; 118/262

[58] **Field of Search** 118/46, 236, 249, 104, 118/203, 211, 247, 262

[56] **References Cited**

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2345183	3/1975	Fed. Rep. of Germany .	
3046257	6/1982	Fed. Rep. of Germany .	
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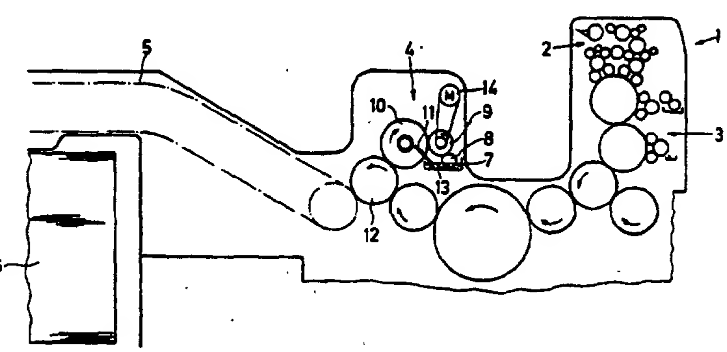
Primary Examiner—Evan K. Lawrence

Attorney, Agent, or Firm—Herbert L. Lerner; Laurence A. Greenberg

[57] **ABSTRACT**

In a printing machine, a medium applicator disposed downstream of printing units of the machine, in travel direction of a sheet which has been printed, the applicator having three rollers including a first roller for taking up medium from a supply container, a second roller for metering a quantity of the medium to be applied, and a third roller having the same diameter as that of cylinders of the printing units for transferring the medium, includes a rubber lining disposed on the third roller for directly applying the medium onto the printed sheet; the three rollers, during application of the medium, being in constant meshing engagement with a sheet-transferring cylinder; a device for uncoupling the three rollers from the sheet-transferring cylinder, and a separate motor for driving the three rollers when the rollers are uncoupled.

6 Claims, 6 Drawing Figures



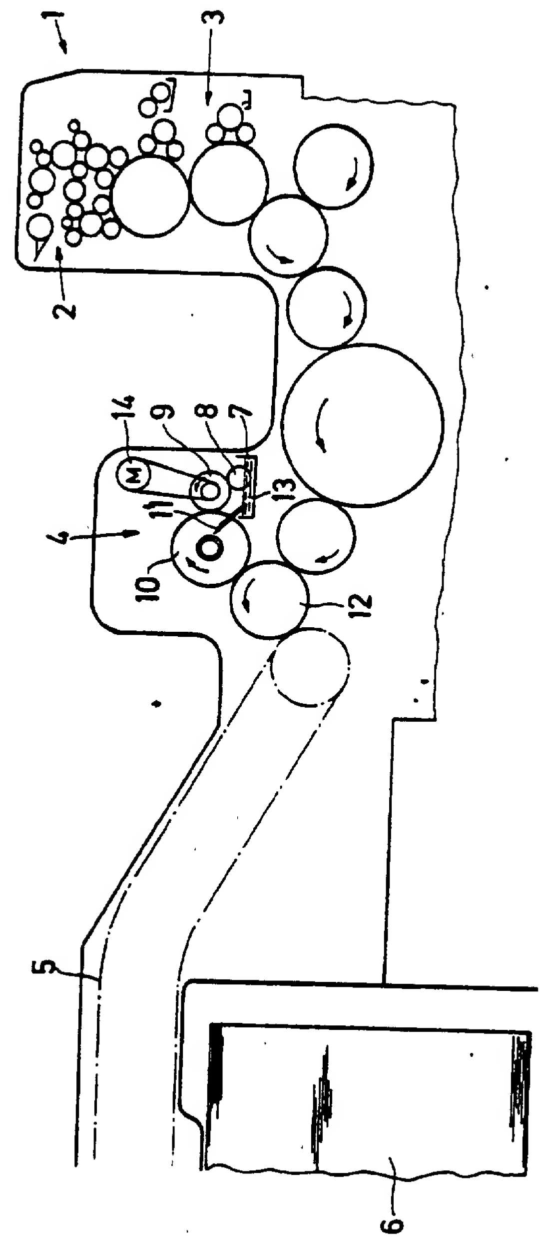


Fig. 1

Fig. 2

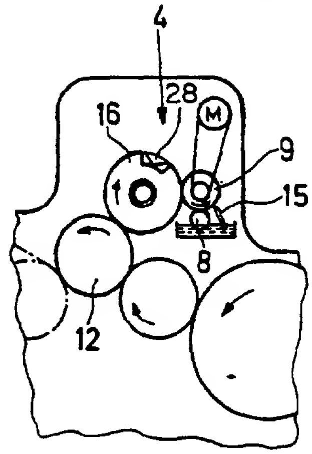


Fig. 3

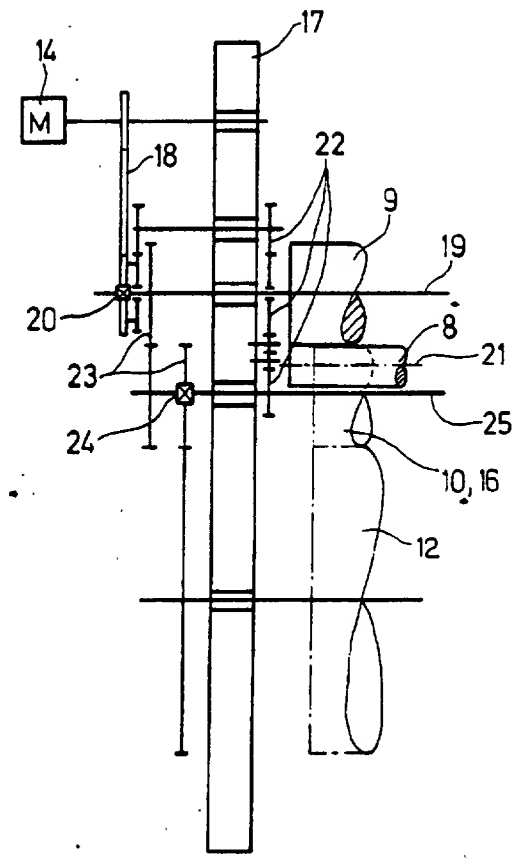


Fig. 4

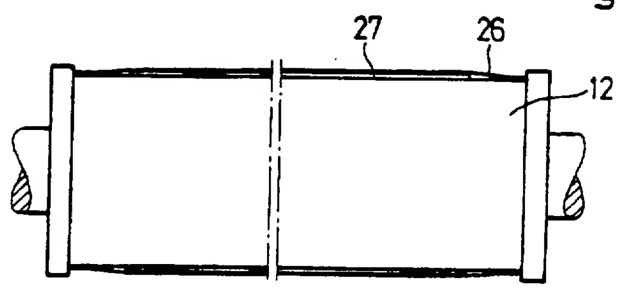


Fig. 5

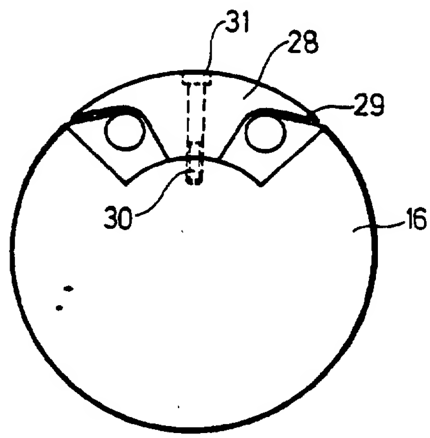
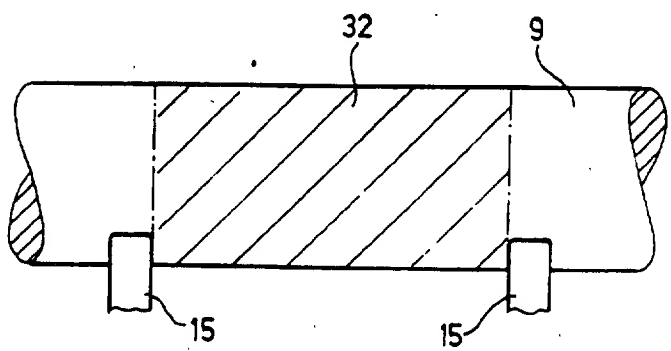


Fig. 6



DEVICE FOR APPLYING MEDIUM AFTER TERMINATION OF THE PRINTING OPERATION IN A PRINTING MACHINE

This is a continuation-in-part application of Ser. No. 626,732, filed July 2, 1984, and now abandoned.

The invention relates to a device in printing machines for applying a medium, such as lacquer, especially, by means of three rollers, after the printing process has been terminated, the rollers including a first roller for taking up medium from a supply container, a second roller for metering a quantity of the medium to be applied and a third roller having the same diameter as that of cylinders of the printing units for transferring the medium to a printed sheet.

A lacquering or varnishing device in printing machines has become known theretofore from German Published Non-Prosecuted Application No. (DE-OS) 30 46 257. This device includes a lacquer storage tank or supply container and a scooping roller dipping into this tank. The lacquer taken up by the scooping roller is fed in metered fashion to an applicator roller. Two ductor rollers, by means of which a format-related lacquer feed occurs, can be set close to the scooping roller. A ductor blade applicable against the metering roller is also provided. This ductor blade serves to wipe superfluous lacquer from the metering roller and to return it to the supply container.

A specific disadvantage of this heretofore known device is that the lacquer is fed to the varnishing or lacquering cylinder via a distributor roller and an applicator roller. Because of the relatively long transport distance which the lacquer has to cover over many rollers until it reaches the printed sheet, the lacquer begins to set i.e. no quick-drying lacquers can be used. Due to this limitation to slowly drying lacquers, when the sheet is delivered the reverse side or back of the next following sheet will smear the lacquer and thus paste the sheets together. Consequently, no full sheet piles can be set up, because the pile weight which is built up at the delivery end and which applies a load to the individual sheets also limits the lacquer layer thickness.

In the device described in German Pat. No. 23 45 183 for applying a medium there are provided a dipping roller, a metering roller, an applicator roller, a back-pressure cylinder, a form cylinder and another applicator roller. The two applicator rollers, the dipping roller and the metering roller are combined into a common structural unit. Within this structural unit, either the dipping roller with the form cylinder or the first applicator roller with the form cylinder or the second applicator roller with the back-pressure cylinder can cooperate.

A disadvantage of this last-mentioned construction is that the lacquer must first be fed to the printed material via the form cylinder. The platen mounted on the clamping device at the form cylinder forms a channel in which the lacquer accumulates after a given operating time. This lacquer-accumulation results in an irregular lacquer application due to dripping of the lacquer down onto the printed material.

German Pat. No. 20 20 584 is based upon a device for avoiding smearing of the ink due to lacquering. By means of a lacquering unit, the lacquer is applied to a printing- unit cylinder. This printing-unit cylinder, which has the same diameter as that of the cylinders of the preceding printing units, transfers the lacquer to the

printed material. The disadvantages referred to hereinbefore are also applicable to this construction and require additionally, time-consuming cleaning work to be performed on the rollers. Moreover, the construction of the printing unit is complicated by having to attach the lacquering unit to the rubber of the blanket cylinder.

A further disadvantage of the state of art as exemplified by the references cited hereinbefore, is that, due to the directions of rotation of the rollers, the format-related wiping by the ductor blade cannot be observed, thus making impossible a precise wiping or removal of the superfluous lacquer material.

It is, accordingly, an object of the invention to provide a device for applying a medium such as lacquering unit in a printing machine, wherein the medium, such as lacquer, has to travel over the shortest possible distance from the storage tank or supply container to the printed material, and wherein drying of the lacquer on the rollers is prevented, when the lacquering unit is connectible and disconnectible, as required.

With the foregoing and other objects in view, there is provided, in accordance with the invention, in a printing machine, a medium applicator disposed downstream of printing units of the machine in the travel direction of a sheet which has been printed, the applicator having three rollers including a first roller for taking up medium from a supply container, a second roller for metering a quantity of the medium to be applied, and a third roller having the same diameter as that of cylinders of the printing units for transferring the medium comprising a rubber lining disposed on the third roller for directly applying the medium onto the printed sheet; the three rollers, during application of the medium being in constant meshing engagement with a sheet-transferring cylinder; means for uncoupling the three rollers from the sheet-transferring cylinder, and separate motor means for driving the three rollers when the rollers are uncoupled.

In accordance with another feature of the invention, the third roller is in the form of a cylinder with a continuous surface.

Due to the fact that the cylinder surface of the applicator roller is not broken by a channel, the lacquer can be applied uniformly. Thus, the burdensome cleaning operations can be dispensed with. Because of the limitation to this relatively small number of rollers, it is possible, for example, to apply the lacquer directly to the sheet after the last ink impression i.e. to bring it on-line. When, for example, printed cardboard, which is to be converted afterwards into packaging material, is provided with such a lacquer layer, then this packaging material receives increased portection thereby which is of advantage during the subsequent transport operation. Moreover, the gloss provided by the lacquer enhances the effect of the impression. The cardboard or pastboard treated in this way is also better protected against environmental influence.

Because the rollers, during the application of the medium are in constant meshing contact with the cylinder, assurance is provided that the subsequent or further treatment of the surfaces of the printed material occurs at the speed of the printing machine.

Disengagement of the lacquering device from the cylinder provides the possibility of excluding a given portion of the impression from any subsequent treatment. The motor provided for driving the rollers of the applicator of lacquering prevents drying of the medium

on the rollers. Thus, the burdensome cleaning activities can be dispensed with for the next operating cycle.

In accordance with a further feature of the invention, the rubber lining on the third roller is a rubber cloth applied in an abuttting manner, the third roller having the same diameter as that of the sheet-transferring cylinder; and the third roller being connected by a single-revolution clutch to the sheet-transferring cylinder.

It is thereby possible to use any type of cylinders, because, in this form of application of the rubber cloth or blanket also, no channel is formed in which the lacquer might otherwise accumulate. The third roller has the same diameter as a printing-unit cylinder.

In accordance with an added feature of the invention, there is provided a ductor blade disposed on at least one of the end faces of the third roller serving to transfer the medium to the printed sheet, the ductor blade being disposed so that when superfluous medium is removed by the ductor blade, the thus removed superfluous medum can flow back into the supply container. Thus, an economical use of the medium, in the further treatment is afforded thereby, and contamination of the printing machine is prevented.

In accordance with an additional feature of the invention, the third roller is in the form of a cylinder having a channel formed therein; and including an insert member received in channel so as to complete a continuous cylinder. By inserting a filling piece or insert member into this channel, which can be covered by a rubber cloth or blanket, the benefits of a full or solid cylinder can also be attained.

When such cylinders are used, in accordance with a concomitant feature of the invention, a ductor blade is disposed on the second roller. Thus, precise metering of the medium or lacquer occurs in conformity with the sheet format. A particularly advantageous metering process is also ensured due to the directions of rotation of the rollers, because, in this arrangement, the applcation of the lacquer is always effected from above.

Other features which are considered as characteristic for the invention are set forth in the appended claims.

Although the invention is illustrated and described herein as embodied in a device for applying medium after termination of the printing operation in a printing machine, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therien without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a diagrammatic elevational view of a printing machine with lacquering unit and a ductor blade assembly arranged at an applicator roller and disposed in front of the delivery unit; and

FIG. 2 is a fragmentary view of FIG. 1 showing the printing machine with lacquering unit and with a ductor blade arranged at a metering roller.

FIG. 3 is a diagrammatic side elevational view of the gearing and uncoupling mechanism for the rollers of the lacquering unit;

FIG. 4 is a diagrammatic axial view of a sheet transferring cylinder of the lacquering unit equipped with a format-related underlay;

FIG. 5 is an end view of one of the rollers of the laquering unit which is formed with a longitudinal channel wherein an insert member is received; and

FIG. 6 is a diagrammatic longitudinal view of the metering roller of the lacquering unit and showing ductor blades disposed thereon.

Referring now to the drawing and first, particularly, to FIG. 1 thereof, there is shown a printing machine with a final last printing unit 1 equipped with a conventional inking unit 2 and a conventional dampening unit 3. This last printing unit 1 is followed by a lacquering unit 4. The printed sheets are fed by the last printing unit 1 to the lacquering unit 4. Subsequent to a final treatment of the sheets by the lacquering unit 4, the sheets are seized by a delivery chain 5 and thus transported to a delivery pile 6.

The lacquering unit 4 which is arranged downstream of or behind the last printing unit 1 in travel direction of the sheets is formed of a dipping roller 8 revolving within a supply container or tank 7, a metering roller 9 and an applicator roller 10 provided with a rubber lining or covering (not shown). At an end face of this applicator roller 10, there is additionally a ductor blade 11. The specific character of the applicator roller 10, which has the same diameter as that of a sheet transferring cylinder 12, is maintained both when it is covered with a separate rubber cloth or blanket and the channel formed therein covered by an insert member or a filling or loading piece, or, alternatively, when a rubber cloth of blanket is applied so that the leading and trailing edges thereof abut. Consequently, it is also possible to limit the application of the lacquer to specific areas. The applicator roller 10 is in direct contact with the cylinder 12 which is provided with an elevator mechanism adapted to the sheet format and on which the printed sheet which is to be further processed is located. This cylinder 12 is equipped with non-illustrated grippers disposed in recesses i.e. the gripper back is at a deeper level than the surface of the sheet which is to be further processed. After the further processing has been completed, the cylinder 12 transfers the sheet to the conveyor or delivery chain 5 of the delivery unit which conveys the sheet to the deliver pile 6.

The storage tank or supply container 7 contains a medium or agent 13 to be used for the further treatment or processing of the printed sheets. This medium may be either a lacquer or a rubber cement or any other agent suited for this purpose. During the rotating movement of the dipping roller 8, the medium 13 is taken up thereby and subsequently transferred to the metering roller 9. The applicator roller 10 which is in direct contact with the metering roller 9 transfers the medium 13 to the surface of the printed sheet which is to be treated.

Because it is hardly possible to prevent the medium 13 from running down over the ends of the applicator roller 10, ductor blades 11 are disposed thereat. The medium 13 running down the ends of the applicator roller 10 is wiped off by the ductor blade 11 and flows back to the storage tank or supply container 7 for reuse. In this way, contamination of the printing machine is prevented and, at the same time, economical use of the medium 13 is enhanced.

The applicator roller 10 is controllable via an impression throw-off which is applied in such a manner that only the applicator roller 10 can be engageable with and retracted from the cylinder 12. Hence, the dipping roller 8, the metering roller 9 and the applicator roller 10

are always in mutual contact. During the application of the medium 13, the rollers 8, 9 and 10 of the lacquering unit 4 are driven via the drive mechanism of the printing machine. The further treatment or processing of the sheets thus occurs, at the operating and printing speed, respectively, of the machine.

When this further or subsequent treatment of the sheets is, for example, not required for a specific portion of the total impression or when the printing machine is stopped for a time, then the lacquering appliance 4 is disengaged from the cylinder 12. In order to prevent the medium 13 from drying on the rollers 8, 9 and 10 during this period of time, a motor 14 which is coupled to the metering roller 9 takes up the driving function and, thus, indirectly also the driving of the dripping roller 8 and of the applicator roller 10 which are in direct contact with the metering roller 9. In this regard the rollers 8, 9 and 10 need not rotate at fully machine speed. Only a few rotations per minute are thus required in order to prevent the drying of the medium 13.

A single-revolution coupling or clutch 24 (FIG. 3), for example, effects the disengagement or decoupling of the lacquering unit 4 from the cyliner 12 when the specific embodiment is one wherein the rubber cloth or blanket has been applied in an abutting manner on the applicator roller.

Another embodiment of the lacquering unit 4 is illustrated in FIG. 2. The dipping roller 8 revolves in the storage tank or supply container 7 filed up with the medium 13, takes up the medium and transfers it to the metering roller 9. A ductor blade 15 is disposed on this metering roller 9 for effecting metered transfer of the medium 13. This metering feature operating in correspondence with a particular format permits the use also of a cylinder 16 interrupted or broken by a channel as an applicator roller. This cylinder 16 is also in direct contact with the sheet-carrying cylinder 12. For effecting disengagement, a single-revolution clutch or coupling 24 (FIG. 3) is used in order that, when the lacquering unit is restarted, the cylinder 16 does not touch down on the sheet at the very place where the channel is located. The drive of the lacquering unit 4 is effected in the same manner as for that of the lacquering unit 4 illustrated in FIG. 1.

The embodiments of this lacquering unit 4 permit the use thereof at all times as another printing unit. Because the applicator roller 10 or the cyliner 16 are rollers covered with a rubber lining or blanket, the possibility is afforded of having an additional impression cylinder and inking unit available, without great expense.

The uncouplability of the three rollers is represented in FIG. 3. The motor 14 is mounted in the side wall 17 located at the drive side of the printing machine, and drives a shaft 19 of the metering roller 9 via a belt 18 and a free-wheeling coupling 20. A shaft 21 of the dipping roller 8 is connected to the shaft 19 via gears 22. Likewise, a shaft 25 of the applicator roller 10 and of the cylinder 16, respectively, is coupled with the shaft 19 of the metering roller 9 via gears 23 and the single-revolution coupling or clutch 24.

The format-related underlay is shown in FIG. 4. Before a rubber blanket 26 is tightened on and around the cylinder 12, a previously calibrated sheet 27 accurately cut to the format being used is laid under. Assurance is thereby afforded that the application of lacquer will occur only in this region.

In FIG. 5, an insert member or filling or loading piece 28 is shown received in a channel 29 formed in the cylinder 16. The insert member 28 which is accommodated to the diameter of the cylinder 16 is fastened in the cylinder channel 29 to the cylinder 16 by a spindle 30 and a screw 31.

As shown in FIG. 6, a lacquer layer 32 applied by the dipping roller 8 to the metering roller 9 is suitably doctored by the displaceably arranged doctor blade 15 in a manner related to the format of the sheet which is to be printed.

There is claimed:

1. In a printing machine, a medium applicator disposed downstream of printing units of the machine in the travel direction of a sheet which has been printed, the applicator having three rollers including a first roller for taking up medium from a supply container, a second roller for metering a quantity of the medium to be applied, and a third roller having the same diameter as that of cylinders of the printing units for transferring the medium, comprising a rubber lining disposed on the third roller for directly applying the medium onto the printed sheet; the three rollers, during application of the medium, being in constant meshing engagement with a sheet-transferring cylinder; means for uncoupling the three rollers from the sheet-transferring cylinder, and separate motor means for driving the three rollers when said rollers are uncoupled.

2. Medium applicator according to claim 1, wherein the third roller is in the form of a cylinder with a continuous surface.

3. Medium applicator according to claim 2 wherein the rubber lining is a rubber cloth applied in abutting manner on the third roller, the third roller having the same diameter as that of the sheet-transferring cylinder, and the third roller being connected by a single-revolution clutch to said sheet-transferring cylinder.

4. Medium applicator according to claim 1, including a ductor blade disposed on at least one of the end faces of the third roller serving to transfer the medium to the printed sheet, said ductor blade being disposed so that when superfluous medium is removed by the ductor blade, the thus removed superfluous medium can flow back into the supply container.

5. Medium applicator according to claim 1, wherein the third roller is in the form of a cylinder having a channel formed therein; and including an insert member received in said channel so as to complete a continuous cylinder.

6. Medium applicator according to claim 1 including a ductor blade disposed on the second roller for ensuring exact format-related metering of the medium.

* * * * *

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United States Patent [19]

Fischer

[11] **Patent Number: 4,753,166**

[45] **Date of Patent: Jun. 28, 1988**

[54] **PRINTING MACHINE INK SMOOTHER**

[75] Inventor: **Hermann Fischer**, Augsburg, Fed. Rep. of Germany

[73] Assignee: **M.A.N.-ROLAND Druckmaschinen** AG, Offenbach am Main, Fed. Rep. of Germany

[21] Appl. No.: **31,699**

[22] Filed: **Mar. 27, 1987**

[30] **Foreign Application Priority Data**

Apr. 24, 1986 [DE] Fed. Rep. of Germany 3613877

[51] **Int. Cl.**[4] **B41F 31/00**

[52] **U.S. Cl.** **101/349**; 101/329; 101/DIG. 14

[58] **Field of Search** .... 101/329, 349, 350, 351, 101/352, 169, 157, DIG. 14, 348

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4,354,449	10/1982	Zink	101/349 X
4,398,463	8/1983	Yessler, II	101/169
4,458,592	7/1984	Junghans	101/349
4,577,557	3/1986	Fischer	101/217

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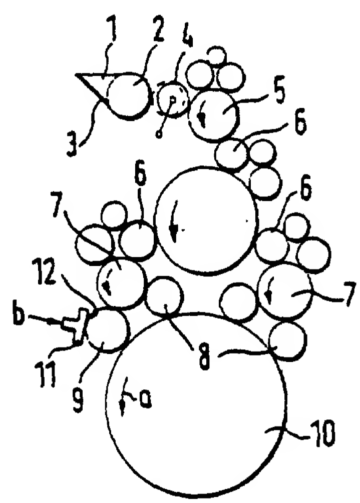
2902230	7/1980	Fed. Rep. of Germany .
3324893	3/1985	Fed. Rep. of Germany .
0154530	3/1982	German Democratic Rep. .

Primary Examiner—David Wiecking
Attorney, Agent, or Firm—Frishauf, Holtz, Goodman & Woodward

[57] **ABSTRACT**

For smoothing an ink film on an ink application roller, so that the ink film on the application roller which is also applied to the plate cylinder will be free from valleys, ridges, striations and the like, a plate-like stamp element (11) is engaged against the circumference of an ink application roller (9), preferably the last one in the direction of rotation of the plate cylinder (10). Preferably, the plate-like stamp element oscillates or reciprocates axially, and is engaged on the surface of the ink application roller (19) by an adjustable spring force (17, 18).

11 Claims, 1 Drawing Sheet



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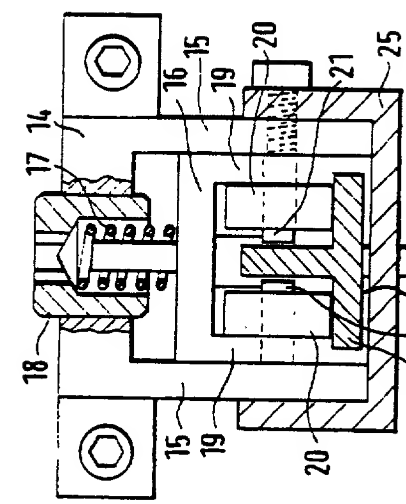

FIG. 3

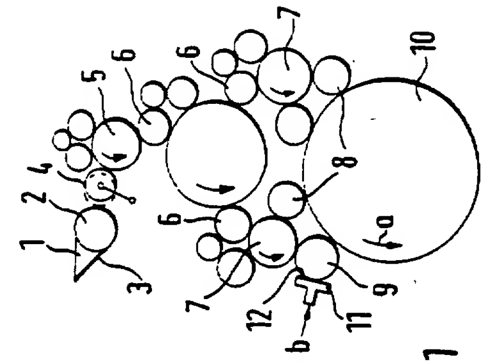

FIG. 1

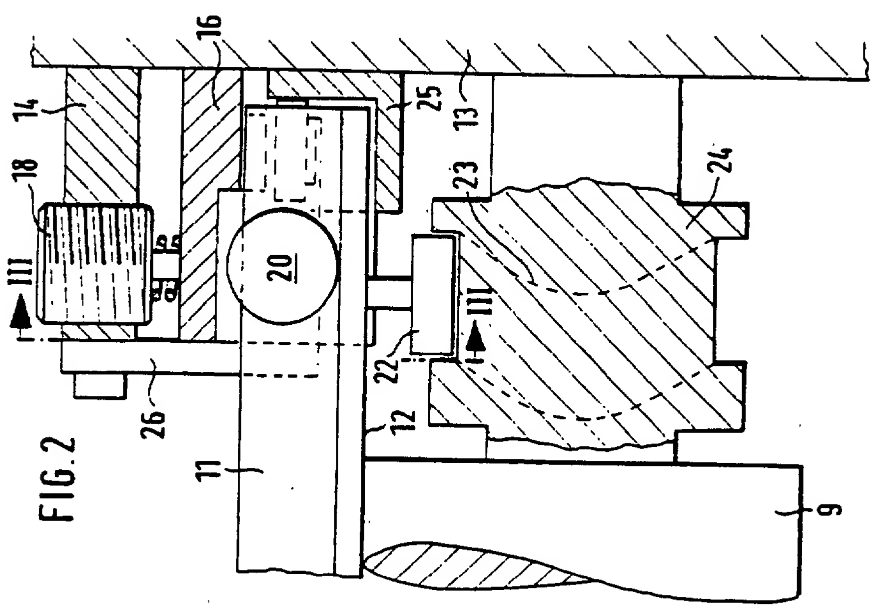

FIG. 2

United States Patent [19]

Fischer

[11] **Patent Number: 4,753,166**

[45] **Date of Patent: Jun. 28, 1988**

[54] **PRINTING MACHINE INK SMOOTHER**

[75] Inventor: Hermann Fischer, Augsburg, Fed. Rep. of Germany

[73] Assignee: M.A.N.-ROLAND Druckmaschinen AG, Offenbach am Main, Fed. Rep. of Germany

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[58] **Field of Search** .... 101/329, 349, 350, 351, 101/352, 169, 157, DIG. 14, 348

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4,354,449	10/1982	Zink	101/349 X
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4,577,557	3/1986	Fischer	101/217

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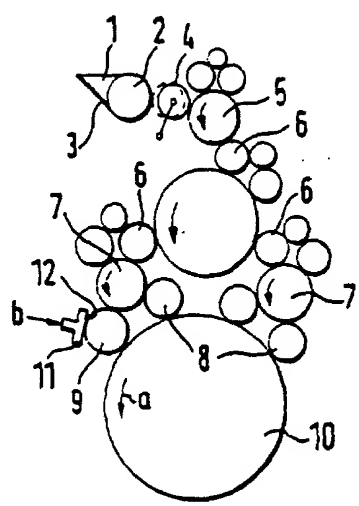
Primary Examiner—David Wiecking

Attorney, Agent, or Firm—Frishauf, Holtz, Goodman & Woodward

[57] **ABSTRACT**

For smoothing an ink film on an ink application roller, so that the ink film on the application roller which is also applied to the plate cylinder will be free from valleys, ridges, striations and the like, a plate-like stamp element (**11**) is engaged against the circumference of an ink application roller (**9**), preferably the last one in the direction of rotation of the plate cylinder (**10**). Preferably, the plate-like stamp element oscillates or reciprocates axially, and is engaged on the surface of the ink application roller (**19**) by an adjustable spring force (**17**, **18**).

11 Claims, 1 Drawing Sheet



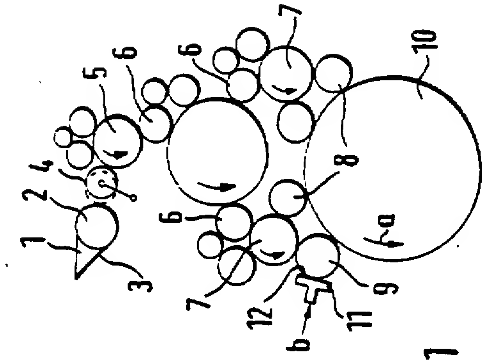


FIG. 1

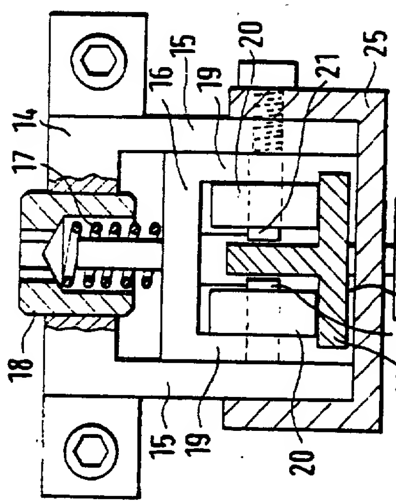


FIG. 3

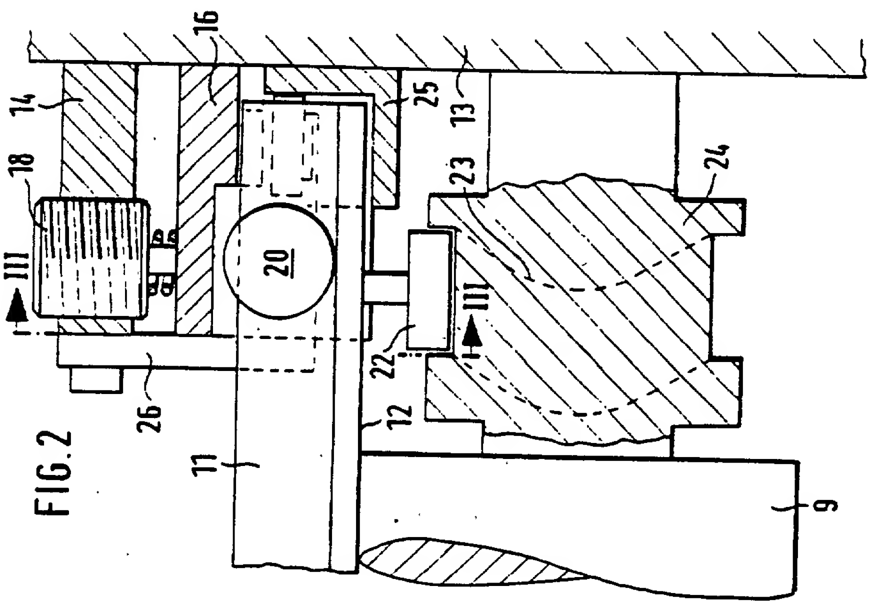


FIG. 2

PRINTING MACHINE INK SMOOTHER

Reference to related patent disclosure: German Patent Disclosure Document No. DE-OS 20 52 806, Kantelberg.

The present invention relates to printing machines, and more particularly to rotary planographic printing machines having an inker which includes an ink trough, ductor or lifter and transfer and milling rollers, and at least one ink application roller; and, especially, to an apparatus to homogenize, or render uniform the ink film on the ink application roller.

BACKGROUND

German Patent Disclosure Document No. DE-OS 20 52 806 describes a printing machine inker in which a plurality of milling rollers, cooperating with an ink application roller, has doctor blades associated therewith. Ink which is stripped from the respective milling rollers is returned to an ink retention vessel. In operation, ink is applied to the respective rollers of the ink train such that more ink is supplied than necessary to ink the plate for printing. Initially, the ink application roller receives an ink layer which is substantially thicker than necessary. This ink layer is then split by the subsequent milling rollers and the ink which is removed from the application roller is stripped off the milling rollers and returned to the ink supply.

It has been found that the actually required ink for the application roller and/or the plate cannot be accurately determined by such a system. Applying a doctor blades to the rollers and/or controlling the operating time and strokes of a ductor roller from an ink trough cannot accurately control the uniformity, or smoothness of the ink supply. Rather, it is necessary to provide multiple splitting of the ink film between the application roller and the respective milling rollers in engagement therewith. However, any uneven ink distribution or ink strips or spots forming peaks and valleys of the ink firlm cannot be completely removed since the ink on the application roller is split at each milling roller into two partial films of equal thickness so that, in general principle, any uneven ink distribution will remain, although to a somewhat decreased absolute extent, while the percentage of change in thickness between the remaining film will continue to be present.

THE INVENTION

It is an object to provide an inker for a planographic rotary printing machine in which ink being applied to the plate cylinder can be accurately determined, and in which any peaks or valleys or non-uniform ink distribution zones are eliminated, so that the resulting ink film on the application roller will be uniform throughout its surface.

Briefly, the ink film on the application roller is rendered smooth by applying thereagainst a plate-like stamp or pressure element which has an essentially flat surface, positioned essentially tangentially with respect to the roller. This plate or stamp element is engaged with the surface of the ink application roller and extends over essentially the entire axial length of the ink application roller.

Some printing machines use more than one ink application roller and, for such installations, each one of the ink application rollers may have the smoothing stamp or plate element applied thereon. In accordance with a feature of the invention, the plate or stamp element may be reciprocated axially, similarly to recirpocation of an axially oscillating milling roller.

DRAWINGS

FIG. 1 is a schematic side view of a printing system including a plate cylinder, and an inker associated therewith;

FIG. 2 is a fragmentary vertical part-sectional view showing the attachment and bearing arrangement for the smoothing plate or stamp; and

FIG. 3 is a cross-sectional view along line III—III of FIG. 2.

DETAILED DESCRIPTION

The inker of FIG. 1, shown highly schematically, has an ink trough 1 in which an inker roller 2 is rotatably retained. Ink is stripped off the roller 2 by a doctor blade 3. A ductor or lifter roller 4 oscillates back and forth in engagement, selectively, with the trough roller 2 and a roller 5 forming part of an ink train. Roller 5 is, preferably, a milling roller, and has other rollers in engagement therewith. Ink is transferred via a group of set of transfer rollers 6 and a milling roller 7 to one or more ink application rollers 8, in engagement with the circumference of a plate on a plate cylinder 10. The specific arrangement of the rollers in the ink train of the inker or of the inker itself is of no significance with respect to the present invention; or for example of the ink supply system.

Besides ink application rolles 8, one of the transfer rollers 7 is in engagement with a further ink application roller 9. Ink application roller 9 is the last one—in the direction of rotation, see arrow a, of the plate cylinder 10—of the ink application rollers in the ink train. In accordance with a feature of the invention, the application roller 9 has a stamp or ink smoothing element 11 positioned tangentially on the surface of the application roller 9. The element 11 has a generally T-shaped cross section, and is formed with a surface 12 in engagement with the surface of the roller 9—see FIG. 2. The smoothing element 11 is pressed against the surface of roller 9 by a force schematically indicated by arrow b in FIG. 1. The cylinder 10 and roller 2-9, of course, have circular-cylindrical surfaces.

The element 11 is held at the two axial ends in the side walls 13—see FIG. 2. FIG. 2 only shows one side end connection, the other side of which can be mirror-symmetrical with respect thereto. The side wall 13 has a support carrier 14 secured thereto, for example by welding. A holder element 16, which is movable, is positioned radially with respect to the application roller 9 between the two side elements 15 of the holder 14. A compression spring 17 is engaged on the holder 16, the other end of which is retained in a counter bearing 18 which is formed as a threaded set bolt, screwed in the carrier 14. By turning the counter bearing 18, the compression of the spring against the holder 16 can be adjusted. Spring 17 provides the force b (FIG. 1). The holder 16 is formed with two side portions 19, each of which supports a roller 20. The rollers 20, thus, are pressed by the action of the spring 17 to the smoothing element 11 and press the smoothing element 11 against the surface of the application roller 9.. The holder 16 further supports two rollers 21, shown only in fragmentary representation in FIG. 3, which engage from both sides against the T-shaped element 11 at the center leg of the T, and thus prevent lateral shift of the T portion

of the element 11. A further roller 22 is secured to the bottom side of the smoothing element 11 to provide for axial—with respect to roller 9—oscillation of the smoothing plate element 11. Roller 22 is guided in a curved groove 23 of a flange 24, rotating with and secured to the application roller 9 or the rotating shaft thereof. Holder 14 additionally has a bottom part 25 which prevents the element 11 from falling out of the holder 15; a front plate 26 insures that the holder 16 cannot move except in a direction perpendicular to the axis of the application roller 9.

OPERATION

During operation of the printing machine, the ink film on the application roller 9 may become uneven, for example showing streaks, valleys, grooves, peaks or ridges; the thus non-uniform ink film on the application roller 9 will be smoothed by the plate portion of the stamp or compression element 11, under pressure of the force b exerted by the spring 17. This pressure can be adjusted. The element 11 will reciprocate axially, by guidance of the cam follower roller 22 in the cam groove 23, and thus any uneveness of the ink film on the application roller 9 wil be smooth and will be rendered uniform. The pressure of the stamp element 11 against the roller 9 should be so adjusted that the element 11 will not squeeze off ink from the application roller 9. The plate cylinder 10, thus, will have ink of uniform thickness applied thereto.

In the example selected, the application roller 9 applied most of the ink to the plate cyliner 10. It is, thus, usually sufficient to equip only the last one of the application rollers with the smoothing apparatus formed by the element 11. Basically, however, a smoothing element like the element 11 can be applied also to other ink application rollers for example any one or more of the rollers 8 as well.

Upon rotation of roller 9, the cam - cam follower arrangement formed by the cam groove 23 and the roller 22 cause axial reciprocation of the element 11. It is not absolutely necessary to provide for axial reciprocation or oscillations; in many cases, the pressure of the stamp element 11 against the application roller 9 provides for sufficient smoothing of the ink layer on the roller 9.

The stamp element 11 does not accept ink from the application roller 9, and thus the reciprocating time of the lifter roller 4 (FIG. 1) or, in film inkers, of the doctor blade 3, can be used to provide for simple and precise adjustment of the ink to be supplied to the plate cylinder.

Various changes and modifications may be made within the scope of the inventive concept.

I claim:

1. In combination with a planographic pringing machine, an inker to supply ink to a plate cylinder adapted to support a planographic printing plate having

an ink supply roller means (1-5) and a plurality of ink distribution rollers (6, 7) forming an ink distribution train;

at least one ink application roller (8, 9) having a circular cylindrical surface in surface engagement with the plate on the plate cylinder, receiving ink from the ink train, and, in operation, accumulating an ink film on the roller,

and comprising, in accordance with the invention, means for smoothing the ink film on the at least one ink application roller (8, 9), including

a plate-like stamp element (11) having an essentially flat surface (12) extending over essentially the entire axial length of the at least one ink application roller; and

means for positioning the plate-like stamp element (11) to engage the flat surface (12) thereof essentially tangentially with the surface of the at least one ink application roller (8, 9) for smoothing the ink film on the at least one ink application roller without squeezing off or splitting ink therefrom.

2. The inker of claim 1, wherein said at least one ink application roller comprises a plurality of ink application rollers (8, 9);

and wherein the plate-like stamp element (11) is in engagement with the last one (9) of said application rollers, with respect to the direction of rotation of the plate cylinder.

3. The inker of claim 1, including bias force means (b; 17) applying a force against the plate-like stamp element (11) to press the plate-like stamp element against the surface of the at least one application roller (8, 9).

4. The inker of claim 3, wherein the bias force means comprises a spring.

5. The inker of claim 3, wherein said at least one ink application roller comprises a plurality of ink application rollers (8, 9);

and wherein the plate-like stamp element (11) is in engagement with the last one (9) of said application rollers, with respect to the direction of rotation of the plate cylinder.

6. The inker of claim 1, further including means (22, 23) axially reciprocating the plate-like stamp element (11) on the surface of the at least one ink application roller.

7. The inker of claim 6, wherein said at least one ink application roller comprises a plurality of ink application rollers (8, 9);

and wherein the plate-like stamp element (11) is in engagement with the last one (9) of said application rollers, with respect to the direction of rotation of the plate cylinder.

8. The inker of claim 1, further including side walls (13) forming a frame for the printing machine;

holder means (14) retaining the plate-like stamp element (11) movably radially with respect to the at least one ink application roller (8, 9), secured to the side walls, said holder means forming said positioning means;

and spring means (17) positioned between the plate-like stamp element and the holder means and, adjustably, pressing the plate-like stamp element (11) against the at least one ink application roller.

9. The inker of claim 8, further including a counter bearing (18) adjustably supporting the spring means (17) on the holder means (14).

10. The inker of claim 8, further including a guide holder (16) positioned, respectively, at each axial end of the stamp element (11) and movably supporting the stamp element on the holder means (14).

11. The inker of claim 1, further including a cam track (23) rotating together with the at least one ink application roller and coupled thereto;

and a cam follower (22), connected to the plate-like stamp element (11) and engaged in said cam track, said cam track being shaped to cause axial reciprocating oscillatory movement of the plate-like stamp element with respect to the surface of the at least one ink application roller upon rotation of said at least one ink application roller.

* * * * *

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United States Patent [19]

Frazzitta

[11] **Patent Number: 4,779,557**

[45] **Date of Patent: Oct. 25, 1988**

[54] **COATER FOR A SHEET FED PRINTING PRESS**

[76] Inventor: **Joseph Frazzitta**, 279 Cherry Pl., East Meadow, N.Y. 11554

[21] Appl. No.: **77,699**

[22] Filed: **Jul. 27, 1987**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 902,782, Dec. 4, 1986, abandoned, which is a continuation of Ser. No. 748,974, Jun. 26, 1985, abandoned.

[51] **Int. Cl.**[4] **B05C 1/02**

[52] **U.S. Cl.** **118/46; 118/224; 118/249; 118/262**

[58] **Field of Search** 118/46, 224, 249, 262; 101/419; 427/428

[56] **References Cited**

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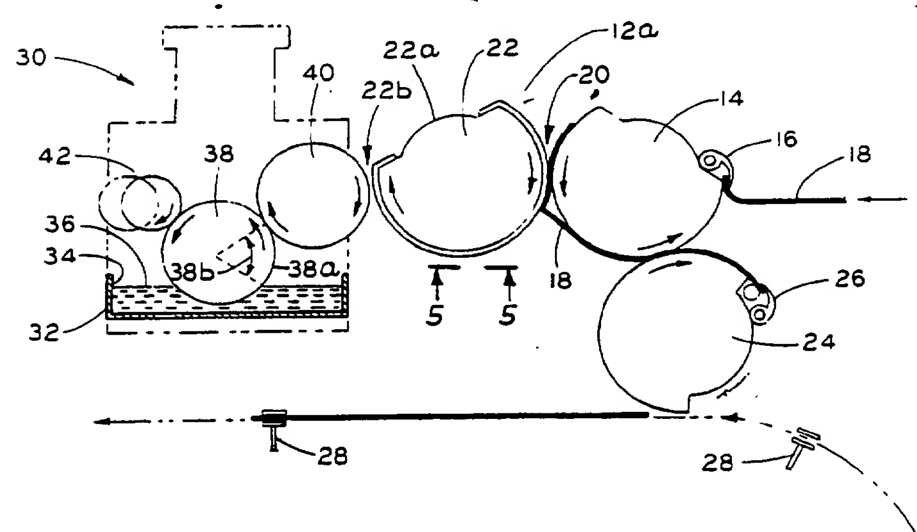
Primary Examiner—Evan K. Lawrence

[57] **ABSTRACT**

A coater for an offset printing press in which the last printing station, i.e., the blanket cylinder roller with its associated sheet-handling grippers, is converted to coating service, such that a pick-up roller, after an ascending arcuate path not exceeding 80°, transfers a liquid coating to an applicator roller rotating in an opposing direction to the blanket cylinder surface which coats the individual imprinted sheets and the liquid coating itself serves as a lubricant permitting said opposing directions of rotation and grippers of said blanket cylinder roller maintain proper handling control of the sheets during the coating thereof. Limiting the arcuate path of 80° obviates reverse flow of the liquid coating on the pick-up roller.

4 Claims, 3 Drawing Sheets



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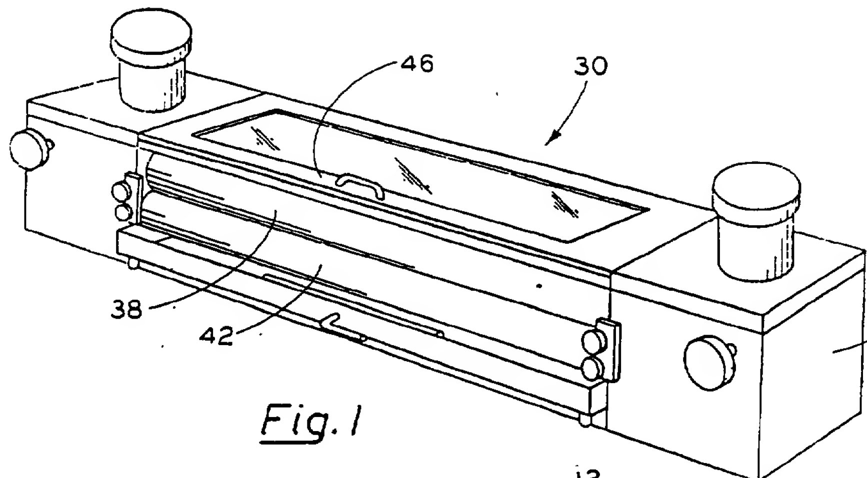


Fig. 1

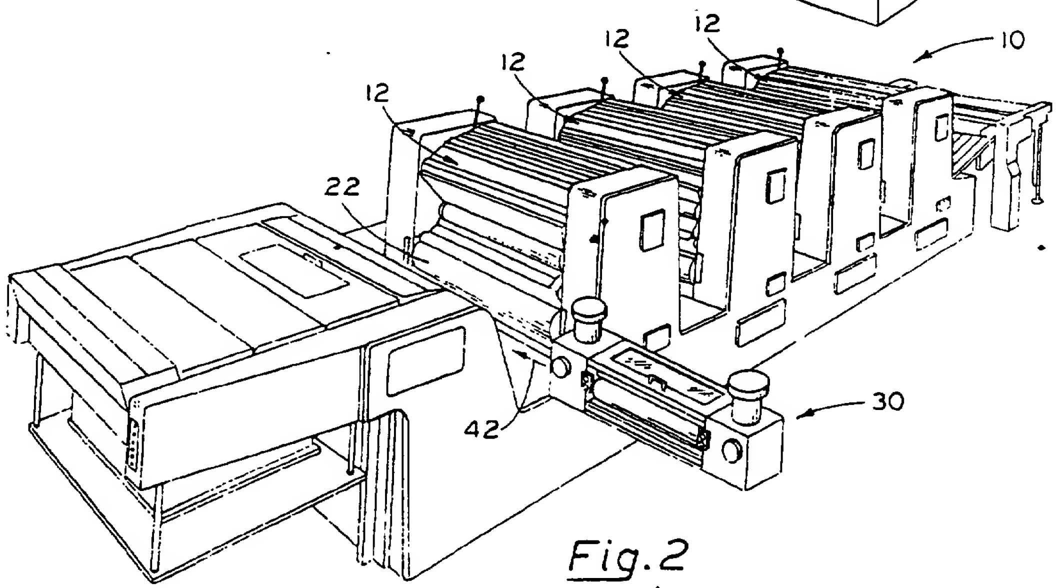


Fig. 2

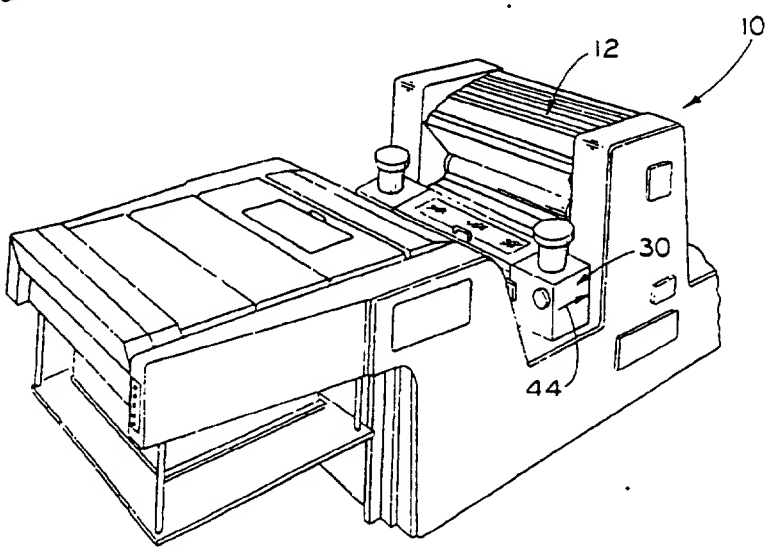


Fig. 3

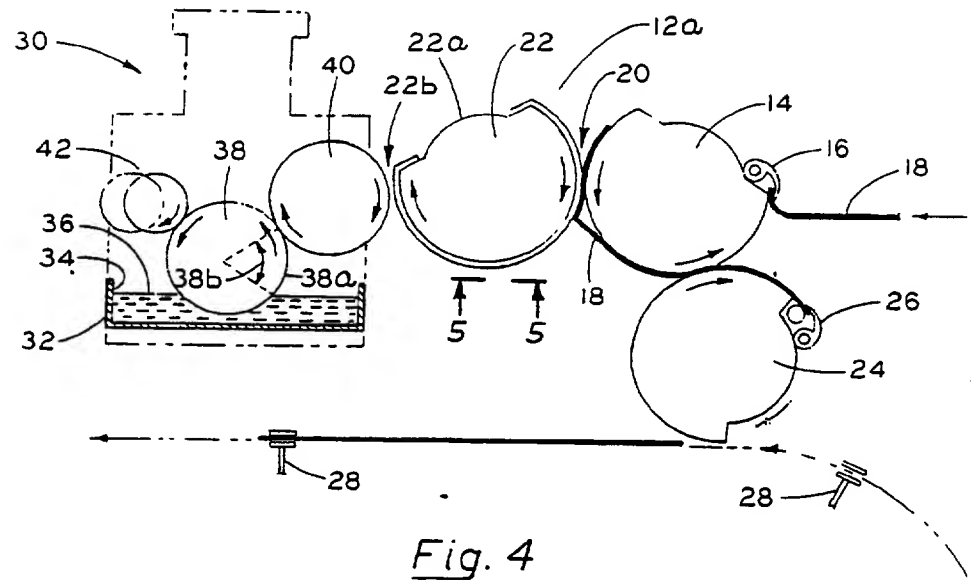


Fig. 4

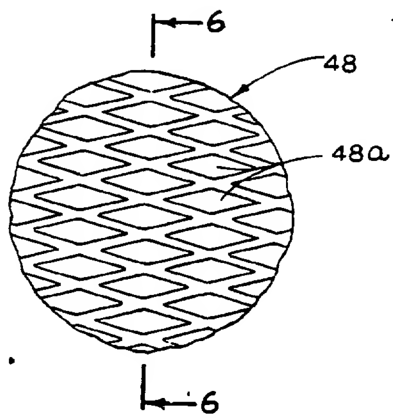


Fig. 5

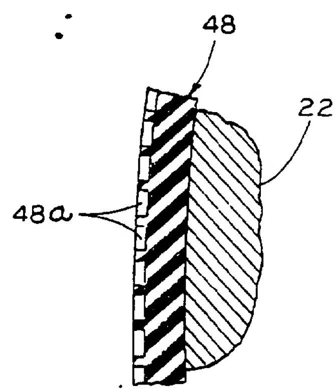
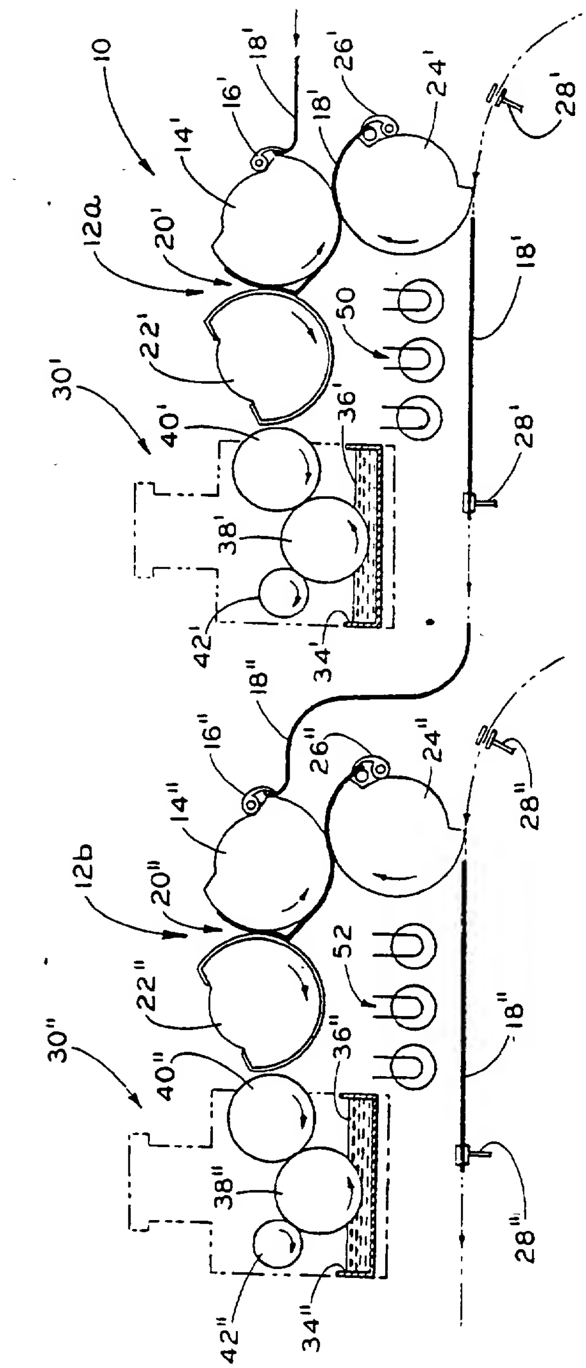


Fig. 6


10
12a
12b
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22'
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42"
50
52

Fig. 7

COATER FOR A SHEET FED PRINTING PRESS

This is a continuation-in-part of application Ser. No. 902,782, filed Dec. 4, 1986, now abandoned, which is a continuation of application Ser. No. 748,974, filed June 26, 1985, now abandoned.

The present invention relates to improvements in coating individual sheets during the printing thereof in an offset printing press, and more particularly to a coating device for an offset printing press that effectively applies a aqueous, ultra-violet or other liquid coating to each imprinted sheet, in turn, without adversely affecting the printing operation of the printing press.

Applying liquid coating to printed material is, of course, already well known, and achieved using coating devices of well-known construction and modes of operation, as exemplified by the coating devices of U.S. Pat. Nos. 3,257,226, 3,029,780, and 3,951,102. These known coaters however are not noteworthy in their effectiveness and, most important, are not compatible with the operation of a standard offset printing press, to which the within invention is applied, as distinguished from a so-called web press. That is, the known coaters are restricted to use with said web press in which a continuous web is fed through the press and a significant degree of tension can therefore be exerted on the web as it is being printed. This ability to apply tension to a continuous web greatly facilitates the application of a coating thereto, whereas applying the same degree of tension to individually fed sheets of an offset printing press, an operating parameter which usually is required during the coating of the individul sheets, may inadvertently cause disengagement of the individual sheet from the grippers and thus seriously adversely affect the printing operation of the standard offset printing press.

Broadly, it is an object of the present invention to provide a coater for an offset printing press handling individually fed sheets overcoming the foregoing and other shortcomings of the prior art. More particularly, it is an object to utilize to advantage the sheet-handling apparatus of the printing press and to combine therewith a surface coating means, so that coating is effectively applied to the imprinted sheets while they are under the handling control of the printing press.

A coater demonstrating objects and advantages of the present invention is applied to a printing press of the type in which individual sheets are imprinted during passage through a nip between a cooperating blanket cylinder roller and an impression cylinder, said nip defining each of plural printing stations operatively arranged in series relation with each other. More particularly, the coater includes an operational mode that contemplates using the last encountered blanket cylinder roller for coating service, rather than printing, and operatively arranging same for counterclockwise direction rotation. Located adjacent the blanket cylinder roller is a storage container for a supply of a liquid coating to be applied to the individually printed sheets having a pick-up roller disposed with a lower portion in the liquid coating supply and operatively arranged for counterclockwise rotation for moving the liquid coating adhered to the surface thereof through an ascending arcuate path of less than 180 degrees, this restricted path being effective to obviate reverse direction flow of said liquid coating along said pick-up roller surface. Completing the rotating components is an applicator roller operatively arranged in contact with the pick-up roller along said arcuate path and also in contact with the blanket cylinder roller, said applicator roller being operatively arranged for clockwise rotation for maximizing the amount of liquid coating transferred thereto from the counterclockwise rotating pick-up roller at the respective surfaces of each which are either in light surface contact with each other or slightly spaced apart. In this way the imprinted sheets are individually coated during passage between the opposite direction rotating applicator and blanket cylinder rollers, said liquid coating serving as a lubricant permitting said opposing direction movements in said applicator and blanket cylinder rollers.

The above brief description, as well as further objects, features and advantages of the present invention, will be more fully appreciated by reference to the following detailed description of presently preferred, but nonetheless illustrative embodiments in accordance with the present invention, when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of a coating device which, in accordance with present invention, is used in cooperating conjunction with a blanket cylinder roller of a standard offset printing press;

FIG. 2 is also a perspective view and illustrates how the coating device of FIG. 1 is moved into its operative position with the blanket cylinder roller of said printing press;

FIG. 3 is a partial perspective view illustrating the operative position of said coating device at a printing station of said printing press;

FIG. 4 is a simplified side elevational view in longitudinal cross section illustrating structural details of the printing press and coating-applying cooperating rollers of the within invention;

FIG. 5 is a partial view as seen along lines 5—5 of FIG. 4 illustrating, on an enlarged scale, structural details of an elastomeric blanket of the blanket cylinder roller;

FIG. 6 is a view in cross section, taken along lines 6—6 of FIG. 5, showing further structural details of the surface of said blanket cylinder roller; and

FIG. 7 is a view similar to FIG. 4, but illustrating the application of two coatings to the sheet fed material at two printing stations.

Illustrated in FIG. 2 and partially in FIG. 3, will be understood to be a standard sheet fed offset printing press, generally designated 10. As is well understood, said standard offset printing press 10 includes plural printing stations, individually and collectively designated 12, at which a separate color is transferred to individual sheets providing a multi-color result. More particularly, and as will be explained in greater detail subsequently, on multi-color presses of which the printing press 10 will be understood to be an example, the transferring of a sheet from one printing station 12 to the next printing station located in line therewith, while keeping said sheet in exact register, is accomplished by means of transfer cylinders whose grippers are timed to take hold of the sheet before they are released by the previous cylinder gripper. For purposes of the within invention, it is important to note that the aforesaid operation of a standard offset printing press differs significantly from a so-called web press, in which a continuous web is fed through the press and a significant degree of tension can therefore be exerted on the web as it is being printed. This ability to apply tension to a continuous web greatly facilitates the application of a coating

thereto, whereas applying the same degree of tension to individually fed sheets of an offset printing press, an operating parameter which usually is required during the coating on the individual sheets, may inadvertently cause disengagement of the individual sheet from the grippers and thus seriously adversely affect the printing operation of the standard offset printing press.

An important contribution of the present invention therefore is the achievement of applying a coating to individually fed sheets of a standard offset printing press, such as press 10, without adversely affecting the printing operation of said press

The manner in which, in accordance with the present invention, individual fed sheets of an offset printing press are effectively coated, can best be appreciated by the simplified cross sectional view of FIG. 4, to which figure reference should now be made. In accordance with the present invention, the last encountered printing station 12, designated 12a in FIG. 4, is incorporated as part of the within inventive coating operation. Printing station 12a, as is well understood, is defined by an impression cylinder 14 having standard cnstructed and operating grippers 16 which effectively grip, in turn, the leading edge of each imprinted sheet 18. Rotation of the impression cylinder 14 carries the gripped sheet 18 to the nip 20 of said impression cylinder 14 and a cooperating blanket cylinder 22. When used for printing, the blanket cylinder 22 prior to the nip 20 receives an ink image from a printing plate (not shown) and effectively transfers this ink image to the sheet 18. In accordance with the present invention, however, the blanket cylinder 22 is not used for printing service, but is used for effectively applying a liquid coating to the individually fed sheets 18, said coating typically being an appropriate chemical for blocking adverse effects of ultra-violet rays or other aqueous coating, or may even be an acrylic water based coating to provide a gloss or otherwise enhance the appearance of the imprinted sheet. The coating may also accelerate the drying of the printing ink applied to the sheet.

Before describing how the liquid coating is applied, it is helpful to complete the description of the operation of the components of the printing press at station 12a. This operation is completed by a transfer cylinder 24 having grippers 26 which in a well understood manner engage the sheet 18 as it exits from the nip 20 and effectively transfers each sheet 18 to sheet-gripping devices 28 of a conveyor which delivers each sheet to a point of discharge.

Thus far what has been described, except for the use at station 12a of the blanket cylinder 22 for coating rather than printing service, is well understood and does not form an essential part of the within invention. The contribution of the within invention, which will now be described, consists of the coating device, shown in isolated perspective in FIG. 1 and generally designated 30 therein, which cooperates with and has an operative position in relation to the blanket cylinder 22, as shown in FIGS. 2, 3, and as now will be described in detail.

Still referring to FIG. 4, the coating device 30 includes a housing 32 which bounds a compartment 34 for the storage of a supply of the liquid coating 36 to be applied to the individual fed sheets 18. Appropriately journaled for rotation in the lower portion of the supply 36 is a pickup roller 38, which, because the blanket cylinder roller 22 is journaled for rotation in a clockwise direction, is itself journaled for rotation in a counterclockwise direction, the reasons for which different directions of rotation will soon be apparent. During counterclockwise rotation of the pickup roller 38, however, a liquid coating which adheres to its surface is raised through an ascending path 38a and is transferred therefrom before the path 38a is as long as 180 degrees. As a result, a liquid which is picked up on the surface of the pickup roller 38 does not travel through an arcuate path of such length that there is reverse flow (i.e., flow in a direction which is opposite the rotational direction of roller 38) in the picked-up liquid coating. Rather, at a point of ascending movement which does not exceed to only 80 degrees as noted by the angle 38b, surface contact is established with said pickup roller 38 by an applicator roller 40 appropriately journaled for rotation in a clockwise direction. Thus, at the surface contact established with the pickup roller 38, the clockwise rotation of applicator roller 40 is in a direction which most effectively transfers a maximum amount of liquid coating from said pickup roller 38 to its surface. On the side of the applicator roller 40 opposite from the pickup roller 38, the surface of the applicator roller is located in a range from being in light contact with the surface of the blanket cylinder 22 to a slight gap 22b spaced therefrom. This light contact or slightly spaced apart relationship of the surfaces of the rollers 40 and 22 is necessitated by the opposing directions of rotation of these rollers. Nevertheless, it has been found in practice that the liquid coating, which may consist of the chemical sold under the trademark SUN CURE by General Printing Ink, division of Sun Chemical of New Jersey, effectively serves as a lubricant which permits the opposing directions of rotation while at the same time there is an effective transfer of the liquid coating from the surface of the applicator roller 40 the surface of the blanket cylinder 22 even, under some operating conditions, across the slight gap 22b. Naturally, there is no transfer in the gap area 22a of the blanket cylinder 22 which gap area must be provided in order to register with the gap area that has to be incorporated in the construction of the impression cylinder 14 because of the grippers 16.

Completing the construction of the coating device 30 is a metering roller 42 which in an appropriate manner is mounted for movement in a clearance position shown in phantom perspective in FIG. 4 into an operative condition shown in full line in FIG. 4, in which latter position it makes contact with the pickup roller 38. The metering roller 42 is only in contact with the pickup roller 38 when the apparatus is running in a standard mode, but said metering roller 42 is disengaged from the pickup roller 38 when the latter is running in a reverse mode (i.e., counterclockwise), thus giving the operator the option of running in either the standard or reverse mode.

Referring now to FIGS. 2 and 3, it is noted for completeness' sake that at the last encountered printing station, which, according to the present invention, is to be used for coating rather than printing service, there is exposure of and therefor ready access to the blanket cylinder 22 of this station. The coating device 30 will be understood to be on appropriate support apparatus, not shown, so that is can be effectively moved from a clearance position to the side of the printing press 10 as shown in FIG. 2, into an operative in line position in the direction 42, said operative position being more particularly illustrated in FIG. 3. In the operative position of FIG. 3 it will then be understood that preferably using pneumatic cylinders which engage the device 30 in its

operative position, that said device is effectively moved in the direction 44 towards the blanket cylinder 22 so that light contact or the slight gap 22*b* is established with said blanket cylinder 22 and the previously referred to applicator roller 40 of the device 30.

As is perhaps best illustrated in FIG. 1, the coating device 30 includes, in addition to the components thereof previously described, a hinged top cover 46, which when opened provides access for making any repairs or replacements to the pickup roller 38, applicator roller 40 or metering roller 42, as well as to the motor which is operatively associated with the metering roller 42 for moving it from its clearance position into contact with the pickup roller 38 and also for the motor which is operatively engaged to drive the pickup roller 38 through rotation. Access through the opening of the cover 46 to the compartment 34 is also necessary for replenishing the liquid coating supply 36.

Special note is made in FIGS. 5 and 6 of a possible elastomeric blanket which is recommended for use for the blanket cylinder 22 to enhance its coating-applying efficiency. As shown in these figures, appropriately mounted about the periphery of the blanket cylinder 22 is an elastomeric blanket 48 having a pattern of surface depressions, individually and collectively designated 48*a*, which are effective in receiving acrosss the nip or gap 22*b* that previously was described as having been established between the applicator roller 40 and blanket 22, a maximum amount of the liquid coating 36 for transfer to the individual fed sheets 18 at the nip 20.

In the apparatus as illustrated and described in connection with FIGS. 2 and 3, the direction of the individual fed sheets 18 are from right to left, and thus the rotation direction of the blanket cylinders 22, including said cylinder at the coating station 12*a*, are in a clockwise direction. It should be readily appreciated, however, that if the delivery of the individually fed sheets 18 were from left to right, that the rotation direction of the blanket cylinders would be in a counterclockwise direction, and that the rotation directions of the moving components of the coating device 30 would then be in the opposite direction than that illustrated and described in connection with FIG. 4. Accordingly, it is to be understood that the within invention, and the claims defining same, contemplate both directions of rotation of the rotating components practicing said invention.

Referring now to FIG. 7, it will be further understood that the within invention contemplates applying a coating to the individual fed sheets 18 at two stations, rather than just one station, as illustrated and described in connection with FIGS. 1–6. A two-station coating process is particularly advantageous in order to achieve a high lamination appearance on the imprinted sheets 18. That is, as understood, in order to presently achieve a high gloss on an imprinted sheet, it is necessary to use a mechanical process in which a plastic film is laminated to the printed substrate. In accordance with the present invention, it is now possible to achieve such a result chemically, rather than mechanically. To do this, and as illustrated diagramatically in FIG. 7, the printing press 10 is modified to the extent of constructing an additional coating station 12*b* down the line from station 12*a* of FIG. 4. In all other respects, except as noted, the structure already described in connection with FIG. 4 is the same, and this similarity is indicated in FIG. 7 by the use of the same reference numerals with a single prime of coating station 12*a*, and a double prime at coating station 12*b*. The only structure added to the setup of FIG. 7 are infrared lamp dryers 50 and 52 located as illustrated at the coating stations 12*a* and 12*b*, respectively. The dryers 50 and 52 will be understood to be of conventional construction and mode of operation and, in lieu thereof, good results can also be achieved using convection hot air units.

Coating station 12*a* is preferred to coat the individual fed sheets 18 with an acrylic water base emulsion which is applied over the sheet 18 previously printed with an oil-based ink. Exposure of the sheet 18*a* to the infrared lamp dryers 50 achieve surface drying thereof. Previously, the drying of the aqueous or ultraviolet coating on the sheet 18*a* invariably resulted in a nominal gloss level in the printed sheet. As a result, it was standard practice to mechanically laminate a plastic film to the printed sheet to obtain a high gloss level in the surface thereof. In accordance with the system of FIG. 7, however, the mechanical lamination is eliminated and in its place there is provided in accordance with the present invention a second coating station 12*b* which preferably applies a high gloss photochemical epoxy resin coating to each individually fed sheet 18" which is transferred from station 12*a* to station 12*b*.

From the foregoing description of the system of FIG. 7, it should be readily appreciated that the process described and illustrated achieves a high gloss appearance in the imprinted sheets 12 that is the same as that achieved by mechanical lamination of plastic film and does so in much less time and without the equipment and apparatus necessary for a mechanical lamination process. The process of FIG. 7 utilizes already existing stations of a multi-station offset standard printing press modified in the manner herein illustrated and described to provide coating, rather printing service.

In the foregoing description, the reference to imprinted sheets and the application thereto of the within inventive coating methods is intended to have specific reference to chemically achieving an ultra high gloss surface over wet ink, an achievement which in the trade would be aptly called "wet trap in line", wherein the "wet trap" signifies achieving a dried ultra high gloss surface trapping wet inks on the paper substrate, and "in line" signifies achieving same during the normal offset printing process rather than, as now done in the prior art, mechanical bonding a plastic film to the printed sheet as a plastic film to the printed sheet as a separate operation.

However, the invention is not limited to a "wet trap in line process", and it is to be further understood that a latitude of modification, change and substitution is intended in the foregoing disclosure, and in some instances some features of the invention will be employed without a corresponding use of other features. Accordingly, it is appropriate that the appended claim be construed broadly and in a manner consistent with the spirit and scope of the invention herein.

What is claimed is:

1. A coater for a printing press of the type in which individual sheets are imprinted during passage between a cooperating blanket cylinder roller and an impression cylinder defining each of plural printing stations operatively arranged in series relation with each other, said coater comprising said last encountered blanket cylinder roller used for coating service rather than printing operatively arranged for clockwise direction rotation, a storage container for a supply of a liquid coating to be applied to said individually printed sheets, a pick-up roller having a lower portion disposed in said liquid

coating supply operatively arranged for counterclockwise rotation for moving said liquid coating adhered to the surface thereof through an ascending arcuate path not exceeding 80 degrees to obviate reverse direction flow of said liquid coating along said pick-up roller surface, and an applicator roller operatively arranged in contact with said pick-up roller to receive said liquid coating thereon adjacent the end of said arcuate path not exceeding 80° and also either in contact with, or spaced by a slight gap from, said blanket cylinder roller, said applicator roller being operatively arranged for clockwise rotation for maximizing the amount of liquid coating transferred thereto from said counterclockwise rotating pick-up roller at the respective surfaces of each in contact with each other and effectively further transferring said liquid coating thereon to said opposing direction moving surface of said blanket cylinder roller operatively arranged at a clearance position therefrom preparatory to said liquid coating being applied to said imprinted sheets at said last encountered printing station, said liquid coating serving as a lubricant permitting said opposing direction movements in said applicator and blanket cylinder rollers.

2. A coater for a printing press of the type in which individual sheets are imprinted during passage between a cooperating blanket cylinder roller and an impression cylinder defining each of said plural printing stations operatively arranged in series relation with each other, said coater comprising said last encountered blanket cylinder roller used for coating service rather than printing operatively arranged for counterclockwise direction rotation, a storage container for a suppty of a liquid coating to be applied to said individually printed sheets, a pick-up roller having a lower portion disposed in said liquid coating supply operatively arranged for clockwise rotation for moving said liquid coating adhered to the surface thereof through an ascending arcuate path not exceeding 80 degrees to obviate reverse direction flow of said liquid coating along said pick-up roller surface, and an applicator roller operatively arranged in contact with said pick-up roller to receive said liquid coating thereon adjacent the end of said arcuate path not exceeding 80° and also either in contact with, or spaced by a slight gap from, said blanket cylinder roller, said applicator roller being opratively arranged for counterclockwise rotation for maximizing the amount of liquid coating transferred thereto from said clockwise rotating pick-up roller at the respective surfaces of each in contact with each other, and effectively further transferring said liquid coating thereof to said opposing direction moving surface of said blanket cylinder roller operatively arranged at a clearance position therefrom preparatory to said liquid coating being applied to said imprinted sheets at said last encountered printing station, said liquid coating serving as a lubricant permitting said opposing direction movements in said applicator and blanket cylinder rollers.

3. A pair of coaters for a printing press of the type in which individual sheets are imprinted during passage between a cooperating blanket cylinder roller and an impression cylinder defining each of plural printing stations operatively arranged in series relation with each other, said coaters comprising two sets of sequentially encountered blanket cylinder rollers used for coating service rather than printing operatively arranged for clockwise direction rotation, and for each said coater and its cooperating blanket cylinder roller, a storage container for a supply of a liquid coating to be applied to said individually printed sheets, a pick-up roller having a lower portion disposed in said liquid coating supply operatively arranged for counterclockwise rotation for moving said liquid coating adhered to the surface thereof through an ascending arcuate path not exceeding 80 degrees to obviate reverse direction flow of said liquid coating to receive said liquid coating thereon adjacent the end of said arcuate path not exceeding 80° and also either in contact with, or spaced by a slight gap from, said pick-up roller along said arcuate path and also in contact with said baanket cylinder roller, said applicator roller being operatively.arranged for clockwise rotation for maximizing the amount of liquid coating transferred thereto from said counterclockwise rotating pick-up roller at the respective surfaces of each in contact with each other and effectively further transferring said liquid coating thereon to said opposing direction moving surface of said blanket cylinder roller operatively arranged at a clearance position therefrom preparatory to said liquid coating being applied to said imprinted sheets at each said encountered printing station, said liquid coating serving as a lubricant permitting said opposing direction movements in said applicator and blanket cylinder rollers.

4. A pair of coaters for a printing press of the type in which individual sheets are imprinted during passage between a cooperating blanket cylinder roller and an impression cylinder defining each of plural printing stations operatively arranged in series relation with each other, said coaters comprising two sets of sequentially encountered blanket cylinder rollers used for coating service rather than printing operatively arranged for counterclockwise direction rotation, and for each said coater and its cooperating blanket cylinder roller, a storage container for a supply of a liquid coating to be applied to said individually printed sheets, a pick-up roller having a lower portion disposed in said liquid coating supply operatively arranged for clockwise rotation for moving said liquid coating adhered to the surface thereof through an ascending aruuate path not exceeding 80 degrees to obviate reverse direction flow of said liquid coating along said pick-up roller surface, and an applicator roller operatively arranged in contact with said pick-up roller to receive said liquid coating thereon adjacent the end of said arcuate path not exceeding 80° and also either in contact with, or spaced by a slight gap from, said blanket cylinder roller, said applicator roller being operatively arranged for counterclockwise rotation for maximizing the amount of liquid coating transferred thereto from said clockwise rotating pick-up roller at the respective surfaces of each in contact with each other and effectively further transferring said liquid coating thereon to said opposing direction moving surface of said blanket cylinder roller operatively arranged at a clearance position therefrom preparatory to said liquid coating being applied to said imprinted sheets to each said encountered printing station, said liquid coating serving as a lubricant permitting said opposing direction movements in said applicator and blanket cylinder rollers.

* * * * *

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United States Patent [19]

Sarazen

[11] **Patent Number: 4,796,528**

[45] **Date of Patent: Jan. 10, 1989**

[54] **SEPARATED INK FOUNTAIN FOR A FLEXOGRAPHIC PRINTING MACHINE**

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[73] Assignee: **M.A.N. Roland Druckmaschinen AG, Offenbach am Main, Fed. Rep. of Germany**

[21] Appl. No.: **56,785**

[22] Filed: **May 29, 1987**

[51] **Int. Cl.⁴** **B41F 31/06**

[52] **U.S. Cl.** **101/208; 101/211**

[58] **Field of Search** 101/207, 208, 209, 210, 101/350, 364, 363

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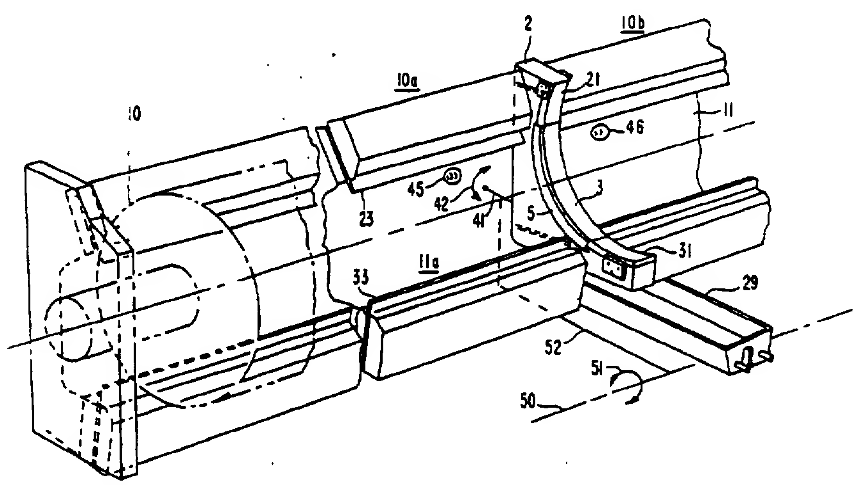
Primary Examiner—J. Reed Fisher

Attorney, Agent, or Firm—Frishauf, Holtz, Goodman & Woodward

[57] **ABSTRACT**

To separate a flexographic ink fountain into axial zones (10a, 10b . . .) to permit use of inks of different characteristics, for example different colors along axial zones of an anilox roller (10), a separator element (2) has an insert strip element (3) extending over a portion of the circumference of the anilox roller, and resiliently engaged thereagainst, for example by compressed silicone rubber (5). Adjacent the end of the strip element (5) are two felt pads (21, 31) which are supplied from a source of separating fluids, such as water, alcohol-water solution or the like, to apply a ring-shaped film of the separating liquid on the anilox roller which film will continue beneath the separating strip (3), the separating strip being engaged against the roller with sufficient pressure to permit the strip to ride on the liquid film, similar to planing of autombile tires on a wet road surface. Two doctor blades are located on a trough structure, selectively moveable away from engagement with the surface of the anilox roller in dependence on rotation of the anilox roller. Additionally, the doctor blades (23, 33) can both be spaced from the surface of the anilox roller by a distance just sufficient to clear the anilox roller (10) thus permitting continued operation of the anilox roller when not in use under idling speed conditions, and preventing drying of ink on the anilox roller. When the doctor blades are removed from the anilox roller, the compressible material, and expansion of the felt pad retains the separating film of liquid on the anilox roller, thus saving "wash up" between extended periods when the machine is not printing while conserving the surface of the anilox roller and the edges of the doctor blades.

19 Claims, 2 Drawing Sheets



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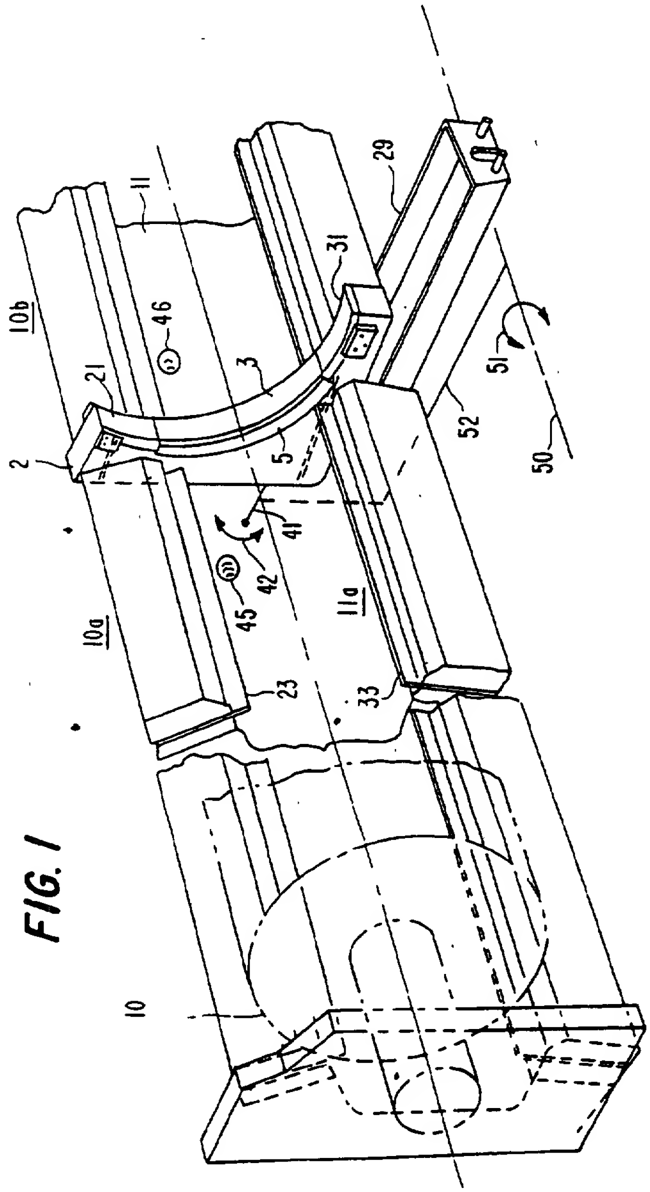

FIG. 1

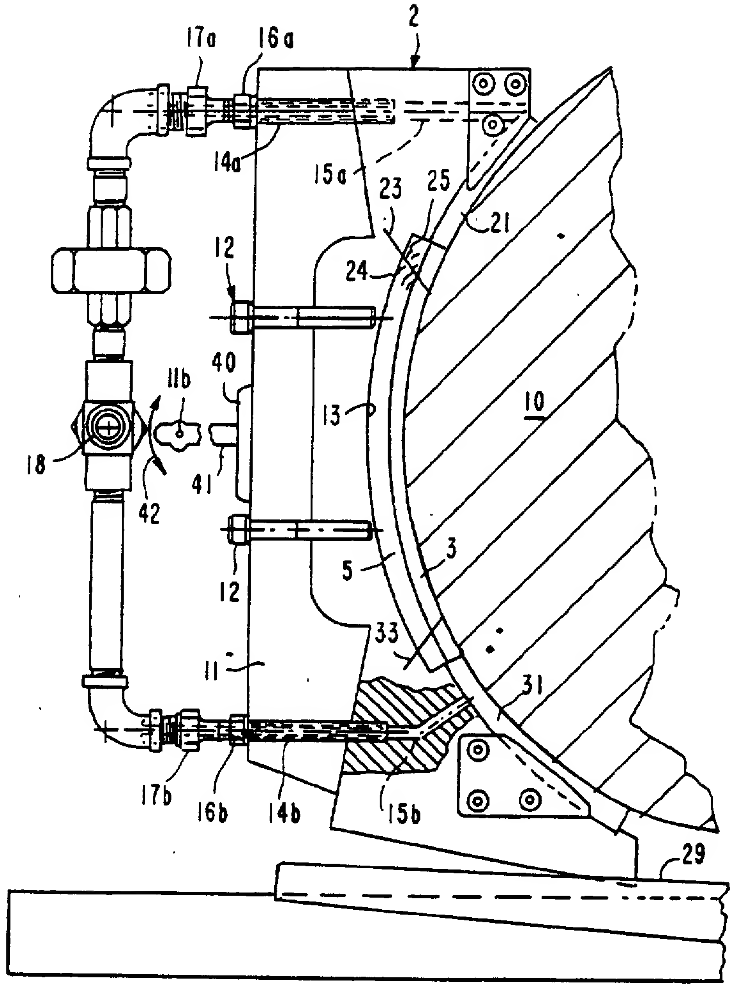
2
17a
16a
14a
15a
23
25
21
24
12
40
11b
13
10
18
41
42
12
3
5
33
11
31
17b
16b
14b
15b
29

FIG. 2

SEPARATED INK FOUNTAIN FOR A FLEXOGRAPHIC PRINTING MACHINE

The present invention relates to printing machines and more particularly to flexographic printing machines, and especially to an ink system or ink fountain therefore, in which the ink fountain is subdivided into axially different zones to permit application of inks of different colors in the respective zones to corresponding zones on an application, or anilox roller.

BACKGROUND

Flexographic printing machines are increasingly used in the printing field. Usually, flexographic printing machines were used to print on bags, wrappers, cartons and boxes. Recently, flexographic printing is being used outside of the packaging field, particularly for books, magazines, stationery and the like A good discussion of flexographic printing is found in "Machine Printing" by Durrant, Meacock and Whitworth, copyright 1973 by Hastings House Publishers, New York, N.Y.

It has previously been proposed to separate inks of different characteristics, for example of different colors with respect to actual zones on an ink ductor roller against which at least one and usualy two doctor blades are engaged, see, for exam U.S. application, Ser. No. 921,338, filed Oct. 21, 1986, now U.S. Pat. No. 4,754,701 Batke et al. This application is directed to a system in which a separating plate is located beneath an axially extending doctor blade. The separating plate has a sealing element attached thereto, resiliently engaging the underside of two doctor blades facing the ductor or trough roller from different directions to permit operation of the ductor or trough roller in either direction of rotation. A low friction surface is applied to the edge which faces the doctor blades, the sealing elements spanning the space between the doctor blades and being matched to the circumference of the ductor or trough roller. The doctor blades extend axially beyond the sealing elements. The separating plates and sealing elements can be mounted on units which are actually positioned along on ink trough and hence the ductor or trough roller, at selected positions, as required by the axial extent of different colored inking zones.

German Patent Disclosure Document DE-OS No. 23 20 638, referred to in the aforementioned Batke patent application, describes an arrangement in which two ink separating sheet metal elements are engaged by spring force directly to the circumference of a ductor roller in order to separate differently colored inks from each other. The lateral sealing of the ink reservoir or ink sump region is obtained by engaging the separating elements against the faced surface of the doctor blades or stripper blades.

THE INVENTION

It is an object to provide a flexible arrangement to separate axial zones on an anilox roller for a flexographic printing machine so that inks of different characteristics, for example of different color can be supplied to the respective zones, without overlap; which is simple, inexpensive and provides for effective sealing of the axial zones with respect to each other.

Briefly, a separating strip element preferably having a low friction surface has a curved surface fitting against and matching the surface of the anilox roller. The curved surface extends over a portion of the circumference thereof. To positively separate the inks of different characteristics, thus preventing migration of ink between the two or more ink zones and to eliminate the effect of abrasion in the water based flexographic inks, a thin film of a hydraulic separating liquid is placed between the strip element and the surface of the anilox roller. Typically,the strip element is made of "Teflon" ®, and the separating liquid is water. Other separating liquids, like water-alcohol mixtures, or ink solvents may be used. The liquid film applied to the region beneath the strip by placing two liquid saturable elements adjacent the end portions of the strip elements. Felt is a preferred material; other spongy materials can be used. Liquid is introduced to the felt elements, which will operate as wicks, to place the thin liquid film just in the region of the separating strip. "Teflon" is a polytetrafluoroethylene plastic.

In accordance with the preferred feature of the invention, the strip element is backed by silicone rubber, for example, of the low durameter type. This permits the seal to become self aligning regardless of direction of rotation of the anilox roller.

Anilox rollers are customarily used with doctor blades. In accordance with the feature of the invention, the doctor blades are cut, or made such that they terminate at the separating elements. The rubber back up permits sealing the corners of the doctor blade inside the ink chambers adjacent to the ink separators, and thus effectively seals the edges of the doctor blades as well, by plastic deformation of the silicone rubber, that is, bulging over the edge upon application of pressure.

In accordance with another feature of the invention, the fountain system is so arranged that a holder structure for the separating strip element, the back-up rubber, and the felt pads or, preferably, the entire ink fountain can be moved for selective engagement of either one of the doctor blades with the anilox roller, in dependence on the direction of rotation of the anilox roller and, further, so moved that both doctor blades clear the anilox roller, while the separating element and preferably also the pads remain in engagement with the surface of the anilox roller. This has the advantage that, during non-printing periods, the anilox roller can be permitted to continue to rotate, with ink being circulated in the ink fountain, thereby preventing drying of the ink on the anilox roller without, however, engaging one of the doctor blades with the anilox roller thereby substantially reducing wear and tear on both the anilox roller as well as the respective doctor blade or blades.

DRAWINGS

FIG. 1 is a general perspective view of a flexographic inker,(wherein the anilox roller is shown in phantom), subdivided axially, in accordance with the present invention;

FIG. 2 is a schematic axial cross sectional view through an anilox roller and showing the ink separator in accordance with the present invention.

DETAILED DESCRIPTION

An anilox roller **10**, of standard construction, and for example of about 28 cm diameter (about 11") is separated into axial zones, corresponding to axial zones **10***a*, **10***b*, or more, in dependence on requirements of the fountain. A separator element **2**, for example of plastic—nylon being suitable—is retained in a suitable portion of the ink fountain, shown only schematically at **11** by screws **12**. Fountain **11**, defining an ink cavity **11***a* is

retained on the machine frame as well known. It can pivot slightly about an axis **11*b*** (FIG. 2) perpendicular to the plane of FIG. 2. The separator element is narrow, and extends over a portion of the circumference of the anilox roller **10**. separator element **2** is formed with a cutout **13** into which a "Teflon"seal **3**, backed up a silicone rubber back-up element **5** is placed. For newspaper printing, a width of the elements **3, 5** of about 15 mm is suitable.

The silicone rubber back-up element **5** uniformly distributes the pressure of the "Teflon" separator strip **3** about the circumference of the anilox roller. Compressive force of the silicone rubber can be obtained by pressure against the anilox roller **10**. Thus, the pressure of the separator strip **3** against the anilox roller can be controlled.

In accordance of the feature of the invention, a thin film of liquid, typically water, is applied between the anilox roller **10** and the "Teflon" separator strip **3**. This thin film of water is derived from two felt pads **21, 31**, which are supplied with water from a water supply duct system. The water supply duct system is formed by a hollow bolts **14*a*, 14*b***, which, are threaded into the separating element **2**, and communicate with ducts **15*a*, 15*b*** formed in the separating element and terminating at the felt strips **21, 31**, respectively. The shapes of the ducts can be matched to any suitable requirement, for example straight, as shown at **15*a***, or angled or bent as shown at **15*b***. A water trough **29**, located beneath the entire assembly, receives any excess or dripping water.

The bolts **14*a*, 14*b*** are threaded at the outside, and nuts **16*a* 16*b*** though not necessary, may be used to retain the bolts against the frame **11**. The bolts **14*a*, 14*b*** are coupled by suitable hydraulic coupling **17*a*, 17*b*** to a hydraulic supply line, shown schematically and including such common hydraulic elements as elbows, unions and the like, as well as, valves **18*a*, 18*b***. Water then can be supplied selectively to the respective felt strips **21, 31**. The felt strips **21, 31** are held in position on the separator element **2** by retaining plates **22, 32**, which engage the felt strips **21, 31**, from both lateral sides; only one of the clamping plates **22, 32**, is visible in FIG. 2.

Doctor blades **23, 33** are selectively engaged with the surface of the anilox roller, and extend axially, that is, perpendicular to the plane of the drawing of FIG. 2. They are secured in position in the fountain. To provide for selective engagement of the doctor blades **23, 33** in dependence on roller rotation, the fountain is pivoted about pivot axis **11*b***. The doctor blades can be pressed axially into the silicone rubber back-up **5**, which will slightly compress and bulge around the doctor blade as schematically shown at **23, 24**, thus providing a tight seal thereagainst. Preferably, the "Teflon" strip **3** is formed with sharp corners. The "Teflon" strip **3** and the silicone rubber back-up **5** can be seated in the recess **13** by being adhered therein, for example by a pressure sensitive adhesive.

The water ducts through the bolts **14*a*, 14*b***, and the connecting ducts **15*a*, 15*b*** through the separator element **2** can be quite small, for example about two to three mm in diameter, just enough to drip water to the pads **21, 31**, so that a hydraulic film will form beneath the "Teflon"® strip **3**, to separate adjacent axial zones **10*a*, 10*b*** . . . . and corresponding zones on the anilox roller. The circumferential length of the felt strips, for a roller of about 28 cm diameter can be about 7 to 8 cm.

Applying a thin film of water between the "Teflon" strip **3** and the surface of the anilox roller **10** has the advantage that the separator strip will not damage the anilox roller and provide a seal with an extended life span which, additionally, is not affected by high rotational speed of the anilox roller **10**. Using water as a film liquid has an additional advantage because it prevents drying of flexographic ink on the anilox roller in the region of ink separation, thus eliminating the abrasive characteristics of water based inks, which otherwise cause wear of sealing material due to build up of dry ink on the anilox roller.

The amount and direction of water flow to be used can readily be controlled by operation of a three way valve **18** in the water supply system to the ducts **15*a*, 15*b***. The quantity can be easily determined by experimentation; just enough water should be used so that the ink separator region does not dry or harden on the anilox roller. Besides the interaction of the water film with the ink, the water will additionally act as a lubricant, and form a hydraulic film around the circumference of the anilox roller. Thus, the "Teflon" strip **3** will ride on the film, and even though the pressure may be considerable, the effect will be similar to that of planing of rolling automobile tires on a road surface which is wetted. This hydraulic film effectively eliminates friction, and prolongs the life of the seal. Just as in planing of automotive tires on a road surface, the friction is low.

Ink migration across the separator is effectively inhibited since the hydraulic film permits liquid to remain only between the anilox roller and the "Teflon" seal, and, in turn, prevents the entrance of ink between the "Teflon" seal and the anilox roller. Thus, migration of ink of one c[characteristic, for example, of one color to ink of another characteristic, for example, of another color is effectively prevented.

Use of a separate rubber back-up **5** is not strictly necessary but preferred. It permits ready replacement and provides uniform even sealing pressure. A low durometer material, for example, a closed silicone rubber of **30** durometer, and located behind the "Teflon" sealing strip provides uniform, even sealing pressure against the face of the anilox roller. The low durometer silicone rubber between the wall of the separating element **2** and the "Teflon" seal also provides for effective sealing of the corners of the doctor blades. This type of silicone rubber permits about 20% compression, which causes the slight side expansion **24,25** of the silicone rubber around the blade ends and corners.

Various materials can be used to form the water film application elements **21, 31**; felt is particularly suitable since it permits a metered dripping or application of water through the separator strip **3**. The water comes with the felt pads **21,31** located above and below the "Teflon" seal. The density of felt is such that an even distribution of water is obtained. The water seeps to the lower portion of the felt pads by gravity.

The arrangement has the additional advantage of low cost. Teflon is substantially more expensive silicone rubber or felt, and using a thin small strip of "Teflon" backed up by silicone rubber with felt pads on either side reduces the amount of "Teflon" used. The "Teflone" is only used in the areas of the ink fountain, between the upper and lower doctor blades.

In accordance with the feature of the invention, the entire ink fountain **11**, together with the separator element **2**, the strip element **3** the back-up element **5** thereof and the doctor blades **23, 33** can be pivoted about the axis **11*b***. The fountain **11** is retained on the machine frame by a bracket **40**, coupled to a holder rod

41 which can be pivoted about the pivot axis 11*b*, as shown schematically by arrow 42. The holder rod 41 is shown broken since the pivot axis 11*b* is usually further toward the left—with respect to FIG. 2—and would not normally be visible in the drawing, for example, being hidden by the valve 18. The location in FIG. 2 has been selected only for clarity of illustration. The fountain 11 is usually trough shaped, to define the ink cavity 11*a*. Ink is continously admitted to the ink cavity by inlet openings 45, and removed by outlet openings 46, ink being continuously circulated in the ink cavity. The anilox roller 10, engaged or just slightly spaced from the doctor blades 23, 33 prevents loss of ink.

In accordance with the feature of the invention, the ink fountain 11 can be removed with respect to the anilox roller 10 such that both doctor blades 23, 33 lose contact with the anilox roller 10. The movement is slight, a fraction of a millimeter. This permits continued circulation of flexographic ink in the ink trough 11*a*, and rotation of the anilox roller 10 at low or idle speed, thereby preventing drying of ink on the roller 10 during periods of time when printing is not being effected, while maintaining separation of inks of different colors, for example, in the different zones 10*a*, 10*b*. The strip, element 3 as well as the pads 21, 31 will expand slightly—after having been compressed—but not sufficient to lose contact with the anilox roller; if one, or both of the pads 21, 31, should lose contact over a portion of the surface, little harm is done; sufficient water will be applied to form a ring-shaped liquid film in alignment with strip 3 around the anilox roller 10 so that the strip 3 will ride, or plane on the ring-shaped film, thereby continuously preventing ink from the zones 10*a*, 10*b* from merging or bleeding over each other while still permitting rotation of the anilox roller, while it remains positioned in front of the ink cavity 11*a*. The movement of the ink trough so that the doctor blades 23, 33 clear—that is, just barely clear the roller 10, while permitting the back-up rubber 5 as well as the pads 21, 31 to expand can be obtained in any suitable manner; as shown in FIG. 1, a common shaft 50 extends longitudinally of the inker, parallel to the ink trough 11. It can be pivoted as shown by arrow 51. Shaft 50 is coupled by an angled lever 52 to the support rod 41, or the bracket 40, respectively of the separator element 2 tilt mechanism.

OPERATION

If the anilox roller 10 operates in clockwise, or forward rotation, the upper felt pad should be removed, and the upper drip system shut off, for example, by turning valve 18 to direct water to lower pad 31. The lower felt pad 31 remains in place and the lower drip or water application system is activated by valve 18 By wick action, pad 31 will apply a thin film of water on roller 10 which will permit strip 3 to ride on the film. Upon rotation of roller 10, a ring of water film will form on the roller 10, separating adjacent zones of ink. Fountain 11 is pivoted about axis 11*b*, see arrow 42, to disengage doctor blade 23. Rubber backing 5 will equalize engagement pressure of strip 3 against roller 10. Upon reversing rotation to counter clockwise or reverse anilox rotation, the lower drip system can be turned off by changing position of valve 18 and the lower felt pad 31 can be removed. The upper felt pad 21 remains in place and the upper drip system is activated. The non-wetted felt pads should be removed to prevent drying. Removal of the felt pad is simple, by merely slipping them out, possibly also loosening holding screws holding the respective clamping plate 22, 32, and then removing the respective felt strips 21, 31.

Under normal printing conditions, 10 may operate at speeds of up to about 800 rpm, for example. If the machine is not printing it has been customary to stop ink flow and engage in a "wash up", to prevent drying of the rapidly evaporating ink on the anilox roller 10 and in the fountain. In accordance with the feature of the present invention, however, the roller 10 can be permitted to continue to operate at idle speed, for example, at about 30 rpm, with ink continuously being circulated between inlets 45 and outlets 46—shown in FIG. 1 only in different ink zones—while separating the ink zones from each other. Upon tilting of shaft 50 in counterclock wise direction of arrow 51, both doctor blades 23 and 33 will be removed from engagement with the anilox roller 10. The tilt axis of shaft 50 is preferably in essential vertical alignment with the axis of rotation of anilox roller 10, and, for example, somewhat below the ink trough 29. The normal compression of the rubber backing 5, when printing, may be about 25% of its nominal., uncompressed thickness; that of the felt pads about 10%. Slightly tilting the fountain 11 permits some expansion of the rubber liner backing 5, and of the felt pads 21, 31, without loss of their function however. Thus, wash up can be eliminated during idling periods; the strip element 3 and the pads 21, 31 will remain in engagement with the roller 10, thus separating ink zones, while preserving the edges the doctor blades 23, 33 and the surface of the anilox roller.

Various changes and modifications may be made within the scope of the inventive concept.

I claim:

1. In a flexographic printing machine,

an arrangement to separate an ink fountain (11) into different axial zones (10*a*, 10*b*) to permit use of inks of respectively different characteristics on various zones of an anilox roller (10) comprising

a separating strip element (3)

and means (21, 14*a*, 15*a*; 31, 14*b*, 15*b*; 18) for introducing a hydraulic film of a separating liquid between the surface of the strip element (3) and the surface of the anilox roller (10), including a pad element (21, 31) of a porous substance, positioned in alignment with said separating strip element (3);

liquid supply means (14*a*, 15*a*; 14*b*, 15*b*) in hydraulic fluid communication with said pad element (21, 31) of the porous substance; and

the separating strip element (3) having a curved low-friction surface fitting against and matching the surface of the anilox roller (10), positioned, with respect to the direction of rotation of the anilox roller, downstream from said pad element (21, 31), and extending over a portion of the circumference of the anilox roller,

the hydraulic film forming a ring of liquid essentially only in the circumferential region of the anilox roller which includes said portion of the circumference thereof, to float the separating strip element (3) on said ring of separating liquid.

2. The arrangement according to claim 1 wherein said separating liquid comprises water.

3. An arrangement in accordance with claim 2 wherein two pad elements (21,31) and two liquid supply means are provided, the respective pad elements being located adjacent extreme ends of said separating strip element (3).

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4. An arrangement in accordance with claim 2 wherein said pad element of porous substance comprise felt means.

5. An arrangement in accordance with claim 1 further comprising a back-up element (5) located adjacent the separating strip element (3) at a side thereof remote from said anilox roller (10), said, back-up element comprising a compressible material.

6. An arrangement in accordance with claim 5 wherein said compressible material comprises silicone rubber.

7. An arrangement in accordance with claim 5 further including a separator element (2) defining a holder structure, said holder structure being formed with a recess (13) extending part circumferentially around said anilox roller, said back-up element (5) being retained in said recess;

and adjustable means (12, 16a, 16b) adjustably engaging the separator element to provide an essentially radially directed force against said back-up element and to compress said compressible material and press the separator element (3) against the surface of the anilox roller (10).

8. An arrangement in accordance with claim 5 further including doctor blade means (23, 33) having an axial length extending up to the separator element, said doctor blade means (23, 33) engaging with an edge portion against said back-up element (5) of compressible material to permit the compressible material to bulge out against the doctor blade means and seal the edge of the doctor blade means.

9. An arrangement in accordance with claim 1 further comprising a separator element (2) defining a holder structure;

resilient support means (5) for resiliently supporting said strip element (3) on the holder structure for essentially uniform part-circular resilient engagement of the strip element with the anilox roller (10);

doctor blade means (23, 33) located on the ink fountain (11); and

means (41, 42; 50, 51, 52;) movably supporting the ink fountain for selective engagement with the doctor blade means with the anilox roller, or disengagement of the doctor blade means by a slight distance sufficient to clear the doctor blade means from the anilox roller while retaining resilient engagement of the strip element (3) with the anilox roller (10) and continued application of separating liquid to he anilox roller by said liquid application means.

10. An arrangement in accordance with claim 9 wherein said means for introducing the hydraulic film of the separating liquid comprises two wick-type pad elements (21, 31) of a porous substance, positioned in alignment with said strip element (3) at extreme ends of the strip elements;

two doctor blades are provided, forming said doctor blade means, a first doctor blade being associated with the anilox roller in one direction of rotation, and a second doctor blade being associated with the anilox roller in reverse direction of rotation;

and wherein the movable support means permits selective engagement with the anilox roller of

(a) the first doctor blade;

(b) the second doctor blade; and

(c) neither doctor blade,

while maintaining the anilox roller (10) in fluid transfer position with at least one of said pad elements (21, 31).

11. The arrangement of claim 1 wherein said separating liquid comprises at least one of water; water-alcohol mixtures; ink solvents.

12. In a flexographic printing machine, an ink fountain (11) including an arrangement to separate the fountain into different axial zones (10a, 10b . . .) to apply ink on an anilox roller (10) in different axial zones thereof and to permit use of inks of respectively different characteristics, for example of different colors, in the various zones

comprising

a separator (2) having a surface facing the anilox roller (10) which extends over a portion of the circumference thereof; said separator including

a separating strip element (3) having a curved surface of low friction material fitting against and matching the surface of the anilox roller;

a back-up means (5) of compressible material secured to said separator element, and retaining said separating strip element (3) in position, extending over a portion of the circumferential dimension of said separator element (2);

a pad element (21, 31) of a fluid pervious, porous substance retained on said separator element (2) adjacent the end portions of the separating strip element (3) and extending away from the end portions of the separating strip element;

fluid supply means (14a, 15a; 14b, 15b; 18) connecting a source of separating fluid to said pad element to apply a separating fluid thereto, and, in turn, form a film of separating fluid on the surface of the anilox roller (10) and between the surface of the anilox roller (10) and the separating strip element (3);

and means (12, 41, 42; 50, 51, 52) for engaging the separator element (2) towards the surface of the anilox roller (10).

13. The arrangement of claim 12 wherein said separating strip element comprises polytetrafluoroethylene; said back-up means comprises silicone rubber; and said pad element comprises a felt pad.

14. The arrangement of claim 12 wherein said separator (2) defines a holder structure;

two pad elements are provided, one each located at an extreme end of the separating strip element;

two doctor blades are provided, a first doctor blade (23) being associated with one direction of rotation of the anilox roller (10) and a second doctor blade (33) being associated with reverse direction of rotation of the anilox roller,

said doctor blades being secured to said ink fountain;

and wherein the engagement means for engaging the separator against the surface of the anilox roller include means (41, 42; 50, 51 52) for movably supporting the ink fountain for selective engagement of either one of said doctor blades with the anilox roller in dependence on the respective direction of rotation of the anilox roller, or disengagement of both doctor blades with the surface of the anilox roller by separating edges of the doctor blades from the surface of the anilox roller by a slight distance to clear the anilox roller while retaining resilient engagement of the separating strip element (3) with the anilox roller and of at least one of said pad elements with the anilox roller to continuously apply separating fluids to the anilox roller and form said film of separating fluid between the surface of the anilox roller and the surface of the separating strip element.

15. The arrangement of claim 12, wherein said separating liquid comprises at least one of: water; water-alcohol mixtures; ink solvents.

16. A method of sealing flexographic printing inks or different colors from each other and separating said inks in axial zones of an anilox roller (10) comprising the steps of:

providing a separating strip element (3) having a low-friction surface which is curved, matches the surface of the anilox roller (10), and extends over a portion of the circumference thereof;

forming a circumferential ring of a film of separating liquid between said zones by applying a porous wick-like pad against the surface of the anilox roller and saturation said pad with said liquid;

resiliently engaging said separating strip element against said ring of the film of separating liquid;

floating said separating element on said film; and

said step of forming the circumferential ring of the film of separating liquid comprises

introducing just enough liquid upstream, in the direction of rotation of the anilox roller, to provide for effectively planing of the separating strip over the film of liquid.

17. Method according to claim 16 wherein said liquid comprises water.

18. Method according to claim 16 for use in a flexographic printing machine having two doctor blades (23, 33) selectively engagable with the anilox roller (10), or separable therefrom,

wherein the step of introducing said film of liquid comprises maintaining said film of liquid on the anilox roller and continuing to float the separating element on said film when the doctor blades are separated from the anilox roller.

19. Method according to claim 16 wherein said separating liquid comprises at least one of: water; water alcohol mixtures; ink solvents.

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United States Patent [19]

Bird

[11] **Patent Number: 4,796,556**

[45] **Date of Patent: Jan. 10, 1989**

[54] ADJUSTABLE COATING AND PRINTING APPARATUS

[75] Inventor: John W. Bird, Westport, Conn.

[73] Assignee: Birow, Inc., Westport, Conn.

[21] Appl. No.: 65,954

[22] Filed: Jun. 24, 1987

[51] Int. Cl.⁴ B05C 11/00

[52] U.S. Cl. 118/46; 118/262; 101/177

[58] Field of Search 118/46, 262, 249; 101/177

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Primary Examiner—Shrive Beck

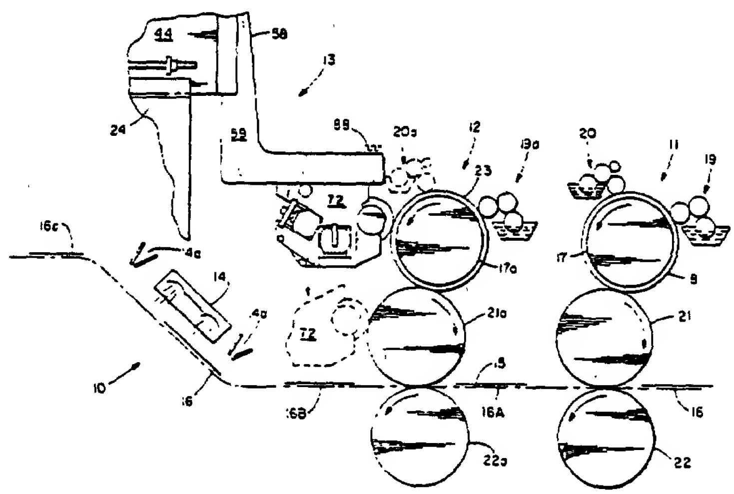
Assistant Examiner—Alain Bashore

Attorney, Agent, or Firm—Peaman & Green

[57] **ABSTRACT**

An offset lithographic printing machine having a plurality of in-line liquid application stations, at least one of which is an ink image printing station for printing lithographic ink images onto suitable receptive copy sheets, and the final downstream liquid-application station being a coating application station for printing a protective, and/or aesthetic coating over selected portions of, or over the entire ink image-printed surface of the copy sheets. The coating application station comprises a plate cylinder adapted to print liquid coating composition onto predetermined selected areas of the ink image-printed copy sheets by offset-transfer to an intermediate blanket cylinder, a said blanket cylinder adapted to receive said liquid coating composition from the plate cylinder for retransfer onto predetermined selected image-printed areas of the image-printed copy sheets, and also adapted to receive a continuous liquid coating composition for retransfer as a continuous overall coating over the image printed areas of the image printed copy sheets. An adjustable coating-application carriage is supported for movement into coating association with either the plate cylinder blanket cylinder desired, for the application of a printed coating over either preselected limited areas or over the entire image-printed surface of the copy sheets.

23 Claims, 4 Drawing Sheets



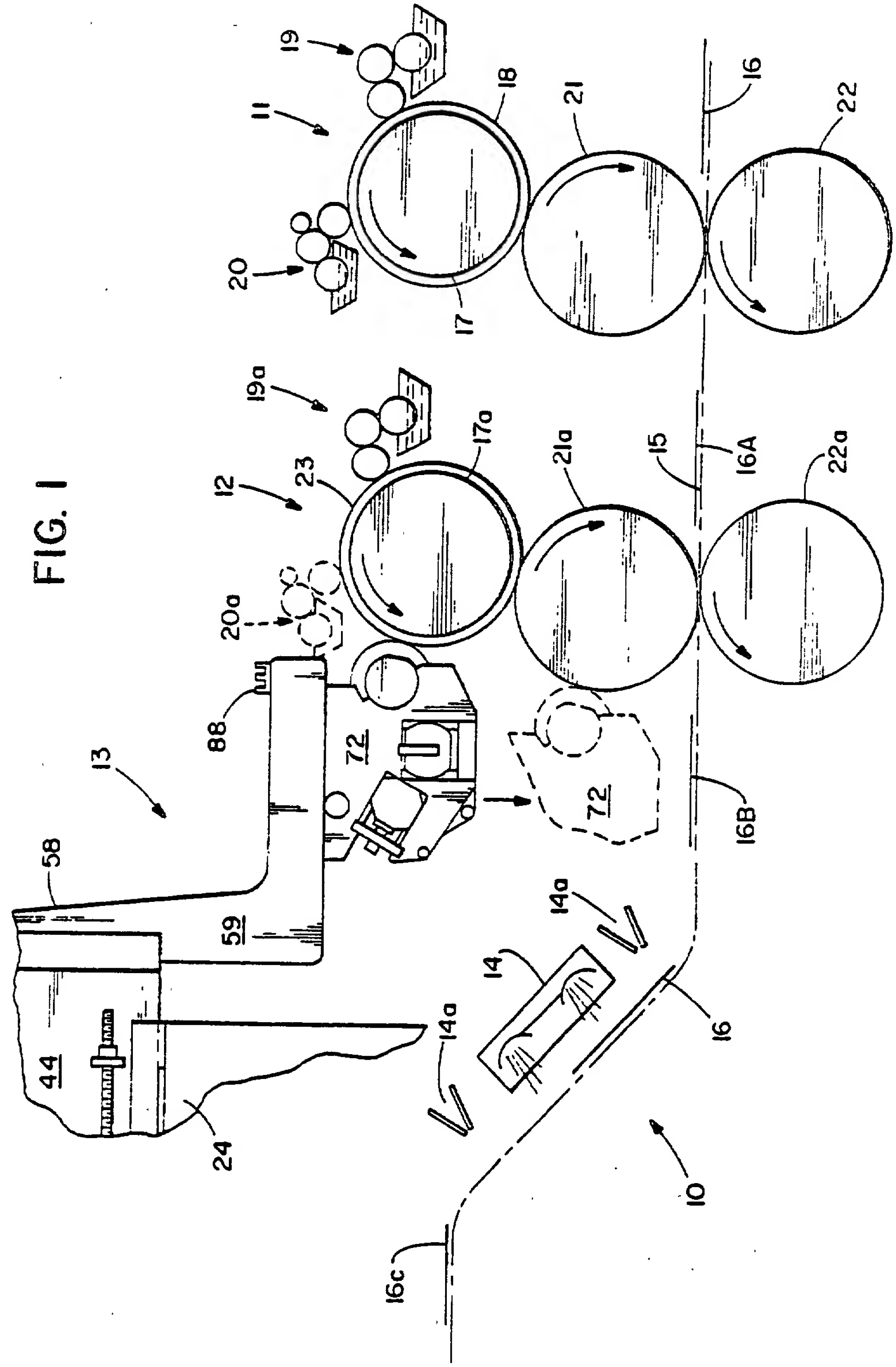

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FIG. 1

FIG. 2A

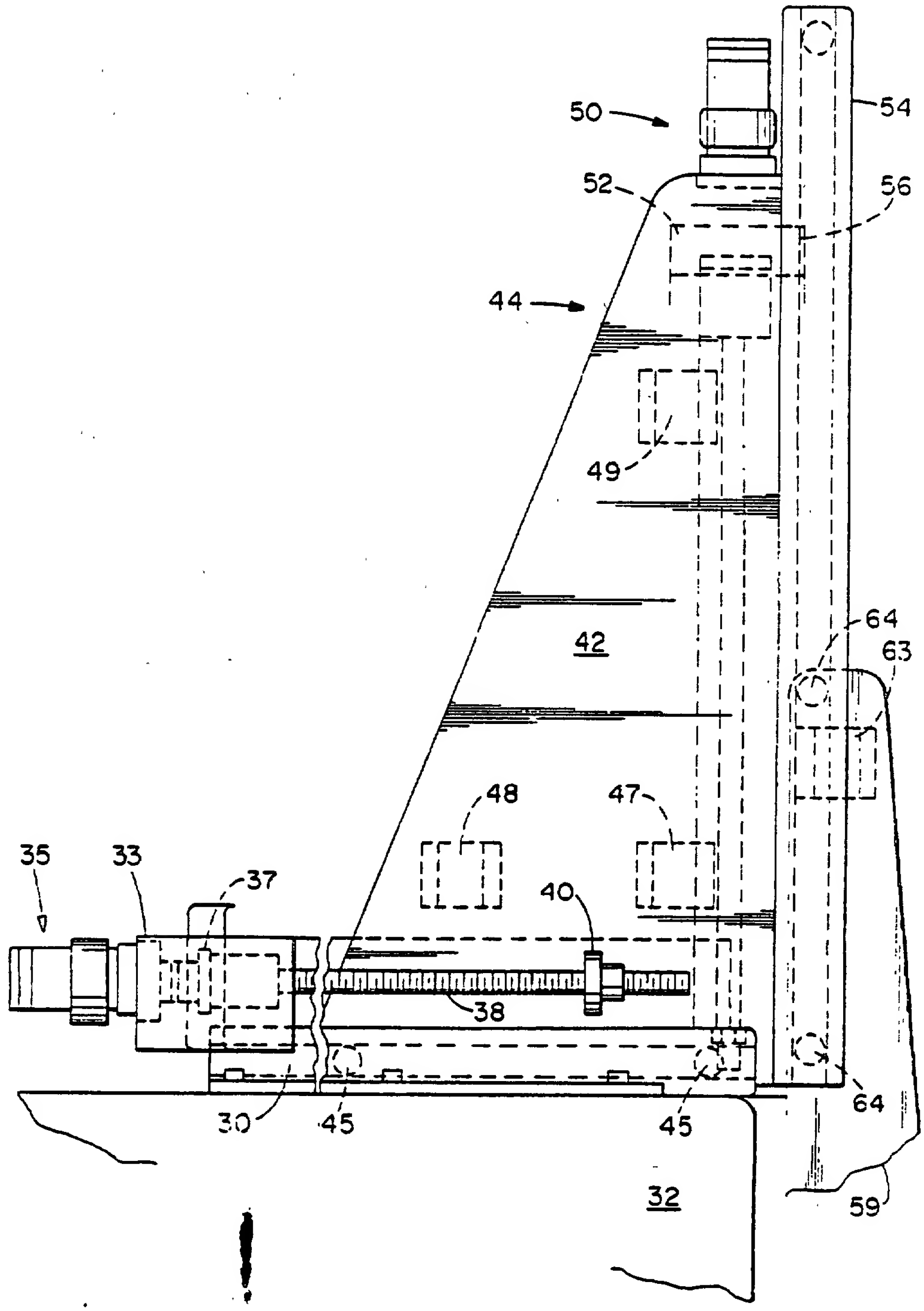

FIG. 2B

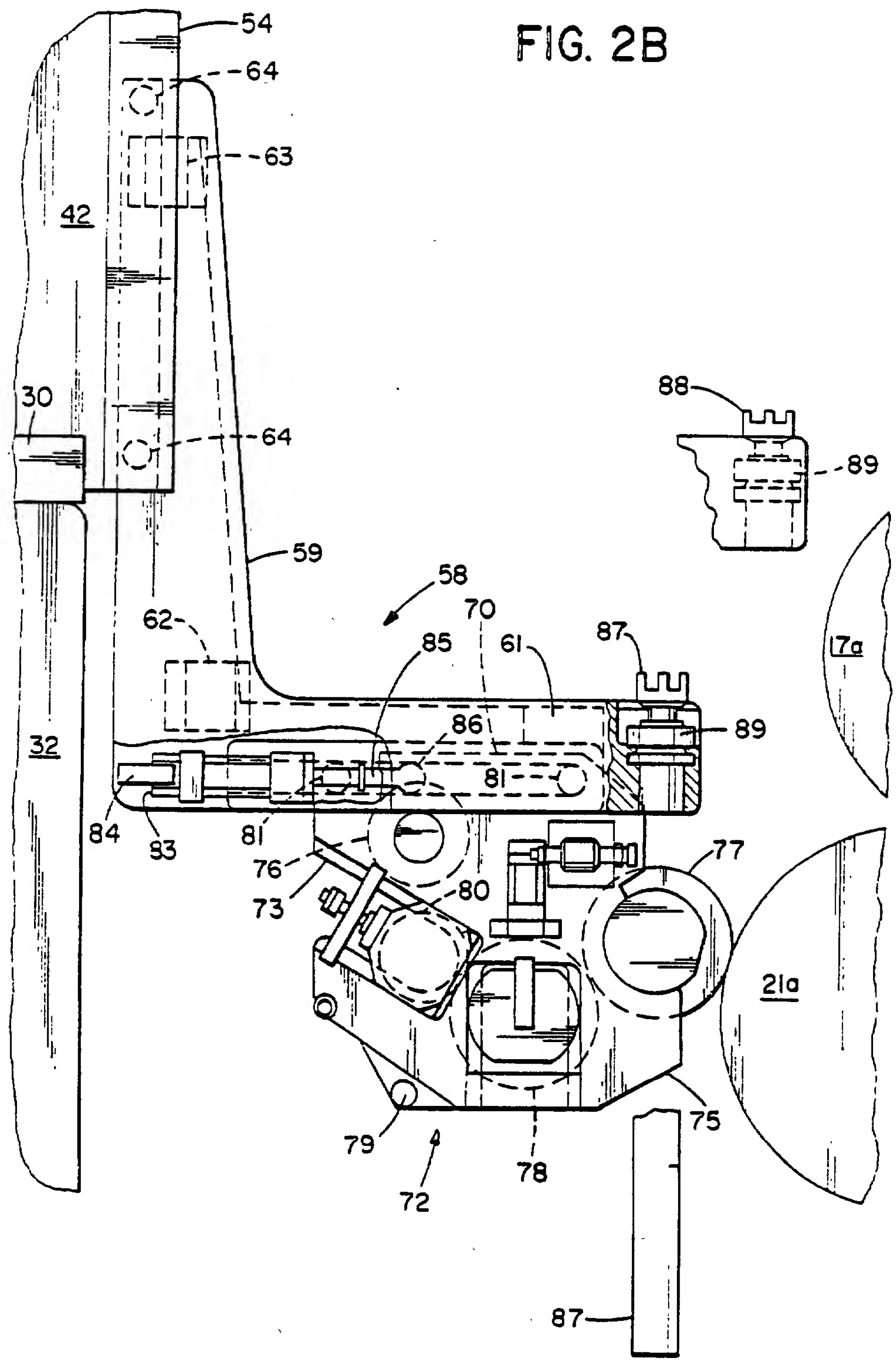
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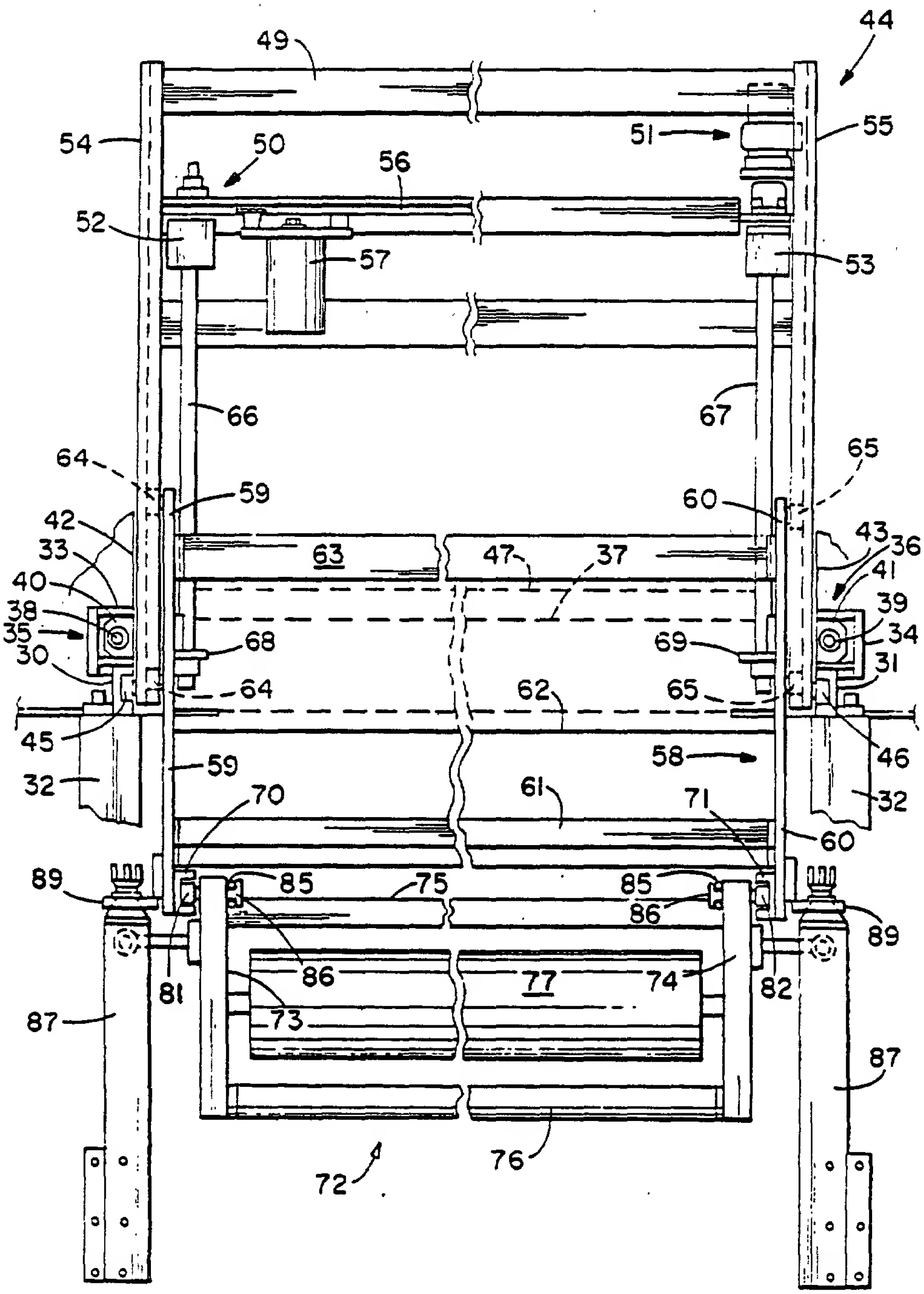
FIG. 3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ADJUSTABLE COATING AND PRINTING APPARATUS

BACKGROUND OF THE INVENTION

Conventional lithographic offset printing machines or presses comprise one or more image printing stations each having a printing roll (sometimes referred to as a plate cylinder) to which is fastened a thin hydrophilic, oleophobic printing plate having image areas which are oleophilic and hyrdoprobic and background areas which are oleophobic and hydrophilic. The plate surface is continuously wetted with aqueous' damping solution which adheres only to the background areas, and inked with oleoresinous ink which adheres only to the image areas of the plate as wet ink. The ink is offset transferred to the rubber surface of a contacting blanket roll (sometimes referred to as a blanket cylinder), and then retransferred to the receptive surface of a copy web or a succession of copy sheets, such as of paper, where the ink air-dries by oxidation and curing after passing through a drying station.

Since image-drying is gradual, it is conventional to spray the printed copies with starch or other "stilting" powder before the copies are stacked. This prevents sticking of the ink images to adjacent copies and also permits the circulation of air for the oxidation curing process.

In cases where cost is not a factor and/or where the aesthetic advantages of a protective supercoating are desired, it is known to provide the printing machine with a downstream coating station having a blanket roll associated with a coating application unit for the application of an overall protective coating over the entire printed area of the copy sheets or web. This also avoids the necessity of powdering the printed images. Reference is made to U.S. Pat. No. 4,270,483 for its disclosure of such an apparatus. The coating unit of U.S. Pat. No. 4,270,483 is pivotally-associated with the blanket roll for movement between coating and noncoating or retracted positions.

It is known to apply pattern coatings of protective composition by means of blanket rolls by cutting into the rubber surface of the blanket to leave raised or relief surface islands which selectively receive the coating composition from the application roll for retransfer to selected areas of the copy sheets in the form of pattern coatings. This procedure has several disadvantages. The make-ready time required for the preparation of such relief blanket rolls is excessive and the procedure requires the tedious, precision efforts of an expert in order to approximate the required registration, whereas precise relief printing plates used on a printing roll can be produced photographically in a short period of time with a minimum of effort and expertise. Moreover, the attachment of a relief printing plate to a plate cylinder provides some degree of adjustability, axially as well as circumferentially, to provide better registration if necessary, whereas no adjustment of the relief portions is possible relative to the blanket roll or cylinder.

Protective coating compositions also improve the appearance of printed documents, particularly high quality, multi-color copies such as posters, record jackets, product brochures, etc., by providing glossy or matte finishes over the entire image-printed surface or over selected image-printed portions thereof such as photographs, product illustrations, etc. Selected area coating, spot coating or perfect registration over predetermined limited printed areas of the copies is advantageous from a cost standpoint since the coating compositions are relatively expensive and the volume required is reduced if the coating is only printed in registration where desired. Also, spot coating is frequently used as a means for highlighting certain portions of the printed copies such as company name or logo, product illustrations, photographs, etc.

While the cost of the protective coating compositions is an important factor, a more important cost factor is the necessity of removing the printed copies from an offset printing press and then running them a second time through a coating machine to print either a full protective coating or a spot protective coating, as desired. This problem is overcome by U.S. Pat. No. 4,270,483 with respect to the in-line printing of overall or continuous protective coatings but the problem of providing in-line spot printing of protective coatings with a minimum of make-ready time and a high degree of precision thickness remains.

SUMMARY OF THE INVENTION

An essential objective of the present invention is to provide a printing machine or press for the printing of imaged subject matter onto a receptive substrate, such as a copy web or a succession of copy sheets, said printing machine having a downstream coating station designed for the application of either continuous or spot coatings, as desired, over the image-printed copies in a continuous in-line process.

Another object of the present invention is to provide a coating apparatus designed to be mounted at the final downstream ink-application station of a conventional offset printing machine or press having a plurality of ink-application stations to convert said machine or press, intermittently if desired, to the in-line application of either continuous or spot coatings, as desired.

Yet another object of this invention is the provision of a single coating application apparatus mounted in association with the final downstream liquid application station of a printing press having a plurality of liquid application stations, each having a plate cylinder, a blanket cylinder and an impression cylinder, the coating application apparatus comprising a coating carriage which is adjustable between one coating position in which it coats the plate cylinder and another coating position in which it coats the blanket cylinder of the final downstream station to convert said station to a coating station for the application of either spot or continuous coatings to the surface of the image-printed copies.

The novel apparatus of the present invention comprises a coating application apparatus for an offset printing machine and a printing machine containing such an apparatus, the coating application apparatus having a movable carriage designed for operative association in one position with the plate cylinder and in another position with the blanket cylinder of the final liquid application station of the offset printing machine, the coating carriage being adjustably supported for automatic movement between said two different coating positions. One coating position brings the coating application roll of the carriage into coating association with the plate cylinder for the offset formation of predetermined printed spot coatings onto predetermined image-printed areas of the copy sheets. The other coating position brings the coating application roll of the car-

riage into coating association with the blanket cylinder for the offset formation of a continuous coating onto the entire image-printed surface of the copy sheets. This enables the printing machine to image-print and coat-print the copy web or sheets in a continuous in-line operation, the apparatus being adjustable in simple fashion with a minimum make-ready time to adapt the coat-print step to the application of either spot coatings or continuous coatings depending upon the requirements of the printing operation. This increases the versatility of the offset printing machine, avoids the need for separate printing machines or for separate runs of the printed stock and enables the in-line precise printing of spot coatings in tight register and adjustable thickness, which was not possible with any prior-known offset printing machine.

The novel apparatus of the present invention enables the final downstream liquid application station of the printing machine to be used as either an ink-printing station or as a coating-application station and permits simple and rapid conversion between such utilities.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical cross-sectional view through two downstream liquid application stations of an offset printing machine, illustrating a coating-application unit according to one embodiment of the present invention;

FIGS. 2A and 2B are segmented, detailed side views of coating application unit of FIG. 1 and

FIG. 3 is a horizontal front view of the coating application unit of FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings, FIG. 1 illustrates a downstream portion of an offset printing machine 10 comprising two liquid application stations 11 and 12, the latter including a coating apparatus 13 comprising a coating carriage 58, a radiation drying station 14 including air knives 14a and a continuous copy sheet gripper system 15 which moves a succession of copy sheets 16 through the printing machine.

The first liquid application station 11 is a conventional offset image printing station comprising a plate cylinder 17, to which is clamped an imaged lithographic printing plate 18 carrying oleophilic image areas, such as words, photographs, etc. on an oleophilic background. The conventional clamping means permits some degree of lateral or axial adjustment and some degree of wrap-around or circumferential adjustment of the plate 18 relative to the plate cylinder 17. Plate cylinder 17 is associated with a dampening system 19 for wetting the entire background surface of plate 18 with aqueous dampening fluid, and with an inking system 20 for inking the imaged areas of the plate 18 with liquid oleoresinous ink.

The inked plate 18 is rotated against the ink receptive surface of a blanket cylinder 21, to which the wet ink images are offset or transferred, and the blanket cylinder 21 is rotated against a copy sheet 16, passed in the nip between the blanket cylinder 21 and an impression cylinder 22, to transfer the wet ink images to the copy sheet 16 and form an image-printed copy sheet 16A which is conveyed to the last liquid application station 12 which includes the coatingapplication apparatus of the present apparatus.

The coating application station 12 can be similar to the inking station 11 with respect to the plate cylinder 17a supporting a printing plate dampening system 19a, blanket cylinder 21a and impression cylinder 22a since in a conventional offset printing machine having a plurality of liquid application stations, all of the stations are generally similar but use different printing plates to image different areas of the same copy sheet with different colored inks. The present apparatus modifies the final downstream inking station to convert it permanently or intermittently to a versatile coating station.

Plate 23 is an offset relief printing plate, preselected areas of which are raised above the background, generally referred to as "relief spots". Such spots are sized and positioned to correspond to areas of the image-printed copy sheets 16a which it is desired to selectively coat.

The essential novelty of the apparatus of FIG. 1 resides in the adjustable coating apparatus 13 which is mounted onto the frame 24 of the printing machine for extension of the coating carriage 58 into the liquid application station 12 for adjustable coating association with either the coating plate cylinder 17a or the coating blanket cylinder 21a, as desired.

The coating application apparatus 13, shown in greater detail in FIGS. 2 and 3, comprises a preferred embodiment of the present invention in that it includes a coating carriage 58 which is horizontally adjustably, in the machine direction, for movement between retracted or passive position and extended or active position, and also vertically adjustable for movement between the levels of the plate cylinder and the blanket cylinder. Moreover, the coating carriage 58 comprises a horizontally adjustable coating applicator unit 72 which is movable in the machine direction between different extended coating positions to accommodate plate and blanket cylinders which are not in vertical alignment, as shown by FIGS. 1 and 2B.

The coating application apparatus 13 of FIGS. 2A and 3 comprises a spaced pair of parallel, horizontal support rails 30 and 31 or legs designed to be bolted to frame portions 32 of the printing machine beyond station 12, rails 30 and 31 each being fastened to a gear housing 33, 34 of a hydraulic horizontal screw drive member 35, 36 connected to each other for simultaneous operation by a drive chain 37. The screw drive members 35 and 36 comprise reversible drive screws 38, 39 which threadably engage nuts 40, 41 which are fixed to the spaced vertical walls 42, 43 of the vertical lift housing 44.

Housing 44 is provided adjacent the bases of walls 42 and 43 with outward projecting cam follower or wheel pairs 45, 46 which are engaged within the horizontal tracks of the rails 30 and 31 to support the vertical lift housing 44 for horizontal movement between extended or active position, illustrated by FIGS. 1 and 2B, and retracted or passive position under the effects of hydraulic activation of the screw drive members 35 and 36. Walls 42 and 43 of housing 44 are fastened together and reinforced by cross-beams 47, 48 and 49.

Vertical or height adjustment of the coating application carriage 58 is made possible by a second pair of associated vertical screw drive members 50 and 51, shown most clearly in FIG. 3, each having a gear housing 52, 53 attached to the upper end of a vertical rail member, 54, 55 of the housing 44, and being connected to each other for simultaneous reversible operation by means of a drive chain 56 through a hydraulic motor 57.

Vertical lift housing 44 supports the vertically adjustable carriage 58 which comprises a spaced pair of L-

shaped side wall members 59 and 60 fastened together by cross-beams 61, 62 and 63. The vertical extensions of wall members 59 and 60 are provided with cam follower or wheel pairs 64, 65 which ride within the vertical tracks of rail members 54 and 55 on the inside of housing walls 42, 43 to raise and lower the vertical carriage section 58 under the activation of the screw drive members 50 and 51 since the drive screws 66 and 67 thereof threadably engage nuts 68 and 69, respectively, which are fastened to the lower ends of the vertical extensions of the L-shaped wall members 59 and 60.

The horizontal extensions of the L-shaped wall members 59 and 60 of the carriage 58 comprise lower horizontal track members 70 and 71 which support the coating application unit 72 of the carriage for horizontal adjustment therewithin.

Coating application unit 72 of carriage 58 comprises spaced, parallel side frames 73 and 74 fastened together by cross members 75 and 76 and supporting coating applicator roll 77, pick-up roll 78 positioned to pick up liquid coating composition from the coating pan 79, and adjustable metering roll 80 positioned to control the amount of coating composition passed by the pick-up roll 78 to the applicator roll 77. The outer surfaces of the side frames 73 and 74 are provided adjacent the top edge of each with a spaced pair of cam followers or wheels 81, 82 which ride within the horizontal tracks of the track members 70, 71 of the L-shaped wall members 59 and 60, to support the coating applicator unit 72 for adjustable horizontal movement within the carriage 58.

As shown by FIG. 2, movement of the coating unit 72 is controlled by a pair of hydraulic cylinders 83 each attached by a bracket 84 to an L-shapedwall member 59, 60 in horizontal alignment with the track members 70 and 71, and having their rod end 85 attached to the inside wall of side frames 73, 74 at posts 86. Activation of the hydraulic cylinders causes the coating unit 72 to move horizontally along track members 70 and 71 to position the leading edge of the applicator roll 77 for coating association with either the coating blanket cylinder 21*a*, as shown in FIG. 2B, or the coating plate cylinder 17*a*, as shown in FIG. 1. Preferrably the printing machine frame is provided with spaced pairs of latch posts 87 and 88 or support brackets associated with the location of the blanket cylinder 21*a* and the plate cylinder 17*a* for engagement within latch brackets 89 attached to the outer surfaces of the horizontal extensions of the L-shaped wall members 59 and 60 in the area of the forward end of the track members 70 and 71. The engagement of the fixed latch post pair 87 within the latch brackets 89 secures the coating applicator carriage 72 in one position for coating the blanket cylinder 21*a*, as shown in FIGS. 2B and 3, while the engagement of the fixed latch post pair 88, shown by broken lines in FIG. 2B, within the same latch brackets 89 secures the coating applicator carriage 72 in another position, shown in FIG. 1, for coating the plate cylinder 17*a*. Such engagement requires a presetting of the sequence and duration of operation of the various hydraulic mechanisms. Engagement and disengagement of the latch brackets 89 on posts 87 and 88 requires vertical movement of the carriage 58 within the vertical lift housing 44 by predetermined directional and timed activation of the vertical screw drive members 50 and 51. Vertical alignment of the latch brackets 89 with the latch post pairs 87 and 88 must first be accomplished. This requires horizontal movement of the vertical lift housing 44 supporting the carriage 58 including the coating applicator unit 72, and is accomplished by predetermined directional and timed activation of the horizontal screw drive members 35 and 36, for movement of the vertical lift housing 44 from retracted, non-coating position to extended, aligned position. Movement of the coating applicator unit 72 into coating position requires predetermined directional and timed activation of the horizontal hydraulic cylinders 83. Adjustable stop members may be incorporated to limit the various movements.

As will be clear to those skilled in the offset printing art, the novel printing and coating apparatus of the present invention enables the modification of a conventional offset printing machine having a plurality of liquid application stations to convert it to a printing and coating apparatus which is adjustable in simple manner for the alternative application of either full coatings or spot coatings. Moreover, such modification may be temporary, if desired, so that the final downstream liquid application station may be used for its intended purpose for the application of printed ink images or for its modified purpose for printing overall or spot coatings. The conversion from printing use to spot coating use merely requires retracting or disengaging the ink applicator roll of unit 20*a* to position shown by broken lines in FIG. 1, replacing the image printing plate on plate cylinder 17*a* with a relief coating plate 23, cleaning the surface of the blanket cylinder 21*a* and moving the coating application unit 13 horizontally from retracted position to extended position. If overall or complete coatings are desired it is only necessary to retract or disengage the plate cylinder 17*a* from coating association with the blanket cylinder 21*a*, without any alteration of the plate cylinder 17*a* or its printing plate 23 or ink application unit 20*a*.

The present coating applicator roll 77 has a substantially smaller diameter than that of the plate cylinder 17*a* or the blanket cylinder 21*a*, the diameters of which are equal. The speed of rotation of the applicator roll 77 is adjustable so that its surface speed may be the same as or slower or faster than the surface speed of cylinders 17*a* and 21*a*, or in reverse rotation thereto, to provide a brushing action relative thereto, if desired. Such brushing action provides a shearing of the coating composition in the nip therebetween, and a relatively heavy or thick direct deposit of coating composition on cylinders 17*a* and 21*a* in cases where the surface speed of roll 77 is faster than that of roll 17*a* or 21*a*. This is desirable particularly for the application of spot coatings, since the coating thickness is always split to about one-half as the spot coating is transferred from the relief plate 23 of plate cylinder 17*a* to the blanket cylinder 21*a*, and further, split to about one quarter when the spot coating is transferred from the blanket cylinder 21*a* to the printed copy sheets 16A. The effect of such inherent splitting is reduced by increasing the coating thickness on the relief areas of plate 23.

In cases where the coating composition is applied directly to the blanket cylinder 21*a*, for the application of continuous coatings to the printed copy sheets 16A, the plate cylinder 17*a* is retracted from contact with the blanket cylinder 21*a* so that the only coating split occurs during transfer from the blanket cylinder 21*a* to the imaged copy sheets 16A.

The offset printing machines to which the present invention applies are conventional machines and therefore the present disclosure does not include details regarding the support structure for the various rolls,

dampening units, inking units, sheet conveyor system, drying station, or copy sheet supplying and stacking stations. In most modern printing machines, the sheet conveyor system is not a gripper belt or chain but rather comprises automatic grippers on a series of contacting impression cylinders and transfer cylinders.

Also, the present coating compositions and systems for providing continuous supplies thereof to the coating applicator unit are conventional in the art.

The terms "vertically" and "horizontally" are used herein and in the appended claims to define general directions of movement, including angular vertical movement from one level to another and/or angular movement in the machine direction. For example, on printing machines where the coating plate cylinder is not in perfect vertical alignment above the blanket cylinder it may be preferable that the vertical rail or track of the vertical lift housing is inclined at an angle similar to the angle from vertical formed by a straight line contacting the surfaces of the plate cylinder and the blanket cylinder to be contacted by the coating applicator roll. Movement of the coating carriage along such an inclined vertical rail is both generally vertical and generally horizontal. Similarly the horizontal track members for the support legs of the apparatus and/or for the coating applicator unit may also be angular to provide some degree of vertical movement in cases where the design of the printing machine frame supporting the present apparatus makes it necessary or advantageous.

It is to be understood that the above described embodiments of the invention are illustrative only and that modifications throughout may occur to those skilled in the art. Accordingly, this invention is not to be regarded as limited to the embodiments disclosed herein, but is to be limited as defined by the appended claims.

What is claimed is:

1. An adjustable in-line coating application apparatus for attachment in association with a dowmnstream liquid application station of an offset printing machine having a plurality of liquid application stations, for converting said downstream liquid application station to a coating application station for applying either continuous or spot coatings over the printed surface of a succession of copy sheets carrying ink images printed thereon at one or more upstream liquid application stations, said downstream liquid application station containing a blanket cylinder positioned to contact said plurality of printed copy sheets and an offset plate cylinder in vertical elevation above said blanket cylinder and supported for adjustment into and out of coating association therewith, said coating application apparatus having vertical guide means, a coating carriage attached to said support for substantially vertical movement along said guide means, said carriage comprising a coating application unit, including a container for a supply of liquid coating composition and an elongate coating applicator roll supported to receive a uniform supply of said composition on the surface thereof and to transfer a uniform supply of said composition to the surface of either a plate cylinder or a blanket cylinder in coating association therewith, and mechanical adjustment means for moving said carriage on said guide means relative to said support vertically between elevations corresponding to the locations of the blanket cylinder and the plate cylinder of an offset printing machine in order to move said coating applicator roll into coating association with either said blanket cylinder or said plate cylinder, as desired.

2. An apparatus according to claim 1 in which the support for said coating application apparatus comprises a spaced pair of parallel elongate horizontal leg members designed to be fastened relative to the frame of an offset printing machine.

3. An apparatus according to claim 2 in which said support comprises a parallel pair of spaced vertical wall members which are fastened to each other to form a vertical guide means on a vertical lift housing for said coating carriage.

4. An apparatus according to claim 3 in which said horizontal leg members comprise horizontal tracks, and said vertical wall members are movably attached to said horizontal tracks to permit horizontal adjustment of the position of said vertical lift housing.

5. An apparatus according to claim 4 in which said coating carriage comprises a parallel pair of vertical side members which are fastened to each other to form said carriage, each said side member being supportingly-engaged by a vertical guide means on a wall member of the vertical lift housing for vertical movement of said carriage relative to said housing.

6. An apparatus according to claim 5 in which each of the vertical side members of the carriage includes a lower, horizontal support extension to which the coating application unit is attached.

7. An apparatus according to claim 6 in which the horizontal support extensions comprise horizontal tracks to which the coating applicator unit is attached to permit horizontal adjustment of the coating applicator unit on the carriage relative to the vertical lift housing.

8. An apparatus according to claim 1 in which said coating carriage comprises releasable latching means for securing the unit relative to the frame of an offset printing machine when the carriage is positioned for movement of the applicator unit into coating association with either the blanket cylinder or the plate cylinder.

9. An apparatus according to claim 5 comprising automatic mechanical means for moving said carriage vertically relative to said vertical lift housing, said means comprising a vertical screw drive assembly one end of which is fastened to a vertical side wall of said housing and the other end of which is fastened to an adjacent vertical side member of said carriage.

10. An apparatus according to claim 4 in which said horizontal adjustment of the position of the vertical lift housing is provided by at least one horizontal screw drive assembly one end of which is fastened to a horizontal leg member and the other end of which is fastened to an adjacent wall member of the vertical lift housing.

11. An assembly according to claim 7 which further comprises means for causing horizontal movement of the coating applicator unit relative to the coating carriage, said means comprising at least one horizontal drive member one end of which is fastened to the applicator unit and the other end of which is fastened to the horizontal support extension of the carriage.

12. An offset printing machine having a frame supporting a plurality of in-line liquid application stations, each station comprising a blanket cylinder positioned to contact a succession of copy sheets to apply liquid thereto, and an offset plate cylinder in printing association with said blanket cylinder to apply liquid to prede-

termined areas thereof for transfer to said blanket cylinder and retransfer to said copy sheets, the final downstream liquid application station comprising a liquid coating station for the application of continuous or spot coatings over areas of the copy sheets which are image-printed with ink in at least one upstream liquid application station which is an ink printing station, said liquid coating station having said plate cylinder and said blanket cylinder in vertical elevation relative to each other and comprising a coating application carriage including a coating applicator unit having a container for liquid coating composition and a coating applicator roll which receives a continuous supply of said liquid coating composition from said container, and vertical guide means for supporting said coating application carriage for mechanically-adjustable vertical movement along said guide means between a first coating elevation position in which said coating applicator roll is in coating association with said blanket cylinder and a second coating elevation position in which said coating applicator roll is in coating association with said plate cylinder, whereby said carriage can be moved mechanically to said first position to cause the application of a continuous liquid coating to the image printed surface of the copy sheets, and can be moved mechanically to said second position to cause the application of spot liquid coatings to predetermined limited areas of the image printed surface of the copy sheets.

13. A machine according to claim 12 in which said carriage is movable out of coating association with said blanket and/or plate cylinders and said final downstream liquid application station is adapted for alternative use as another ink printing station.

14. A machine according to claim 12 in which the means for supporting said coating application carriage includes a spaced pair of horizontal leg members designed to support the coating application carriage in association with final downstream liquid application station.

15. A machine according to claim 12 in which the means for supporting said coating application carriage includes a parallel pair of vertical wall members which are fastened to each other and to said guide means to form a vertical lift housing for said carriage.

16. A machine according to claim 15 in which said vertical wall members are movably attached to horizontal track members to permit horizontal adjustment of the position of said vertical lift housing relative to the blanket and plate cylinders.

17. A machine according to claim 16 in which said coating carriage comprises a parallel pair of vertical side members which are fastened to each other to form said carriage each said side member being supportingly engaged by a vertical guide means on a wall member of the vertical lift housing for vertical movement of said carriage relative to said housing and between at least said first and second coating positions.

18. A machine according to claim 17 in which each of said vertical side members of the carriage includes a lower horizontal support extension to which the coating applicator unit is attached.

19. A machine according to claim 18 in which said horizontal support extensions comprise horizontal tracks to which the coating applicator unit is attached to permit horizontal adjustment of the coating applicator unit relative to the coating carriage and the blanket and plate cylinders.

20. A machine according to claim 12 in which the frame of said machine includes first position latching means associated with the blanket cylinder, and second position latching means associated with the plate cylinder in said coating application station, and said coating carriage includes mating latching means which engage said position latching means when the carriage is moved into said first coating position and into said second coating position.

21. A machine according to claim 17 comprising automatic mechanical means for moving said carriage vertically relative to said vertical lift housing, said means comprising at least one vertical screw drive assembly one end of which is fastened to a vertical side wall of said housing and the other end of which is fastened to an adjacent vertical side member of said carriage.

22. A machine according to claim 16 which comprises automatic means for providing horizontal adjustment of the position of the vertical lift housing comprising at least one horizontal screw drive assembly one end of which is fastened to a horizontal track member and the other end of which is fastened to an adjacent wall member of the vertical lift housing.

23. A machine according to claim 19 which further comprises means for causing horizontal adjustment of the coating applicator unit relative to the coating carriage, said means comprising at least one horizontal drive member one end of which is fastened to the applicator unit and the other end of which is fastened to the horizontal support extension of the coating carriage.

* * * * *

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United States Patent [19]

Kota

[11] **Patent Number: 4,815,413**

[45] **Date of Patent: Mar. 28, 1989**

[54] **VARNISHING APPARATUS FOR PRINTED SHEET**

[75] Inventor: **Toshio Kota, Ibaraki, Japan**

[73] Assignee: **Komori Printing Machinery Co., Ltd., Japan**

[21] Appl. No.: **919,144**

[22] Filed: **Oct. 15, 1986**

[51] **Int. Cl.**[4] **B05C 1/02**

[52] **U.S. Cl.** **118/46**; 118/249; 118/262

[58] **Field of Search** 118/46, 231, 262, 249

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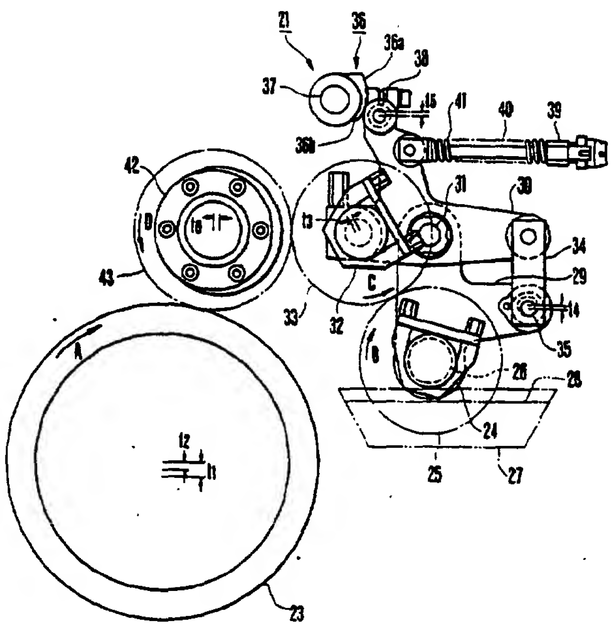
Primary Examiner—John McIntosh

Attorney, Agent, or Firm—Remy J. VanOphem

[57] **ABSTRACT**

A varnishing apparatus for a printed sheet includes: a metering roller, to a peripheral surface of which a varnish from a varnish duct is transferred; a form roller which is brought into contact with a downstream side of the metering roller and is rotated in the same direction as that of the metering roller to allow transfer of the varnish from the metering roller; and a rubber blanket cylinder which is brought into contact with a downstream side of the form roller and is rotated in a direction opposite to that of the form roller to allow transfer of the varnish from the form roller, the rubber blanket cylinder having a notch on its outer peripheral portion and transferring the varnish onto a sheet which is in contact with its peripheral surface. The surface of the metering roller is formed of an elastic material having a roughened surface.

7 Claims, 3 Drawing Sheets



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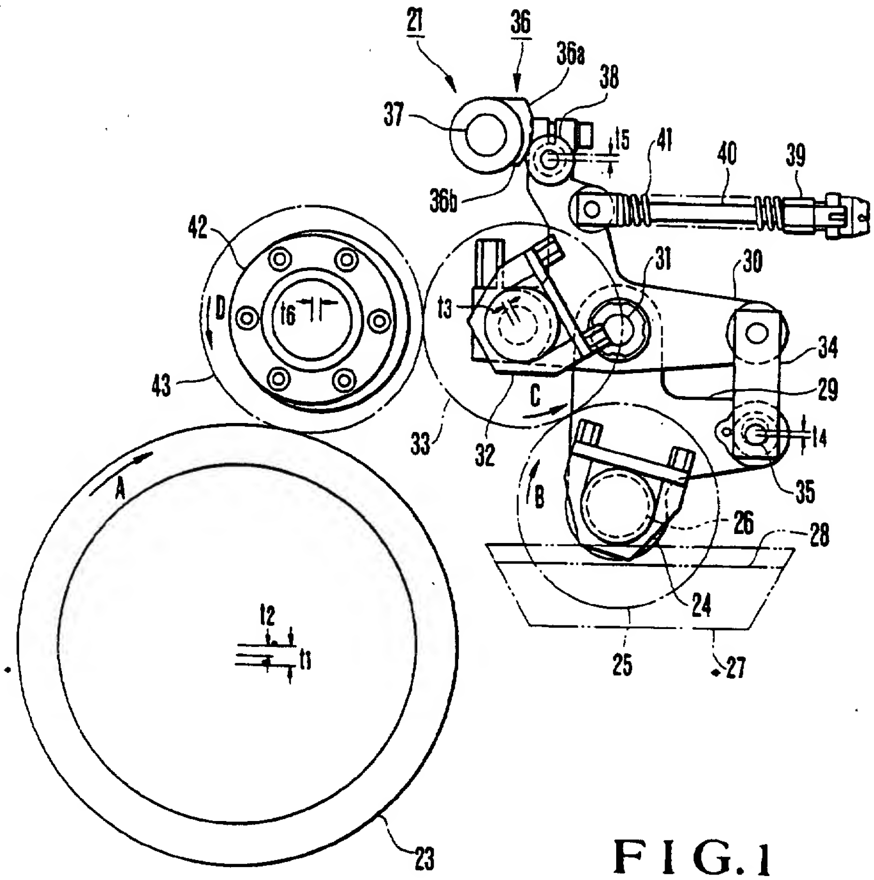

FIG.1

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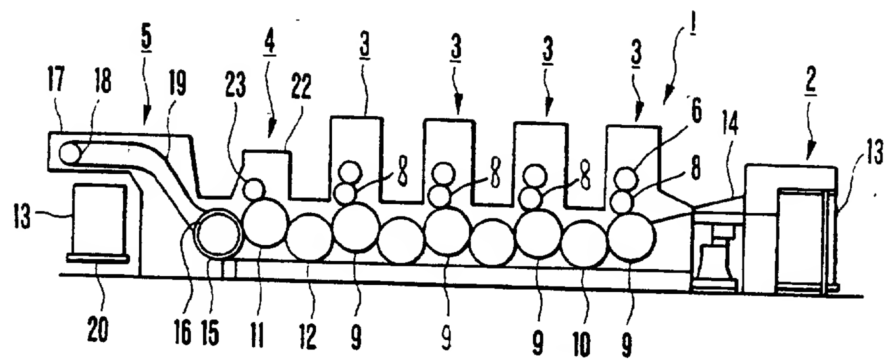
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FIG.2

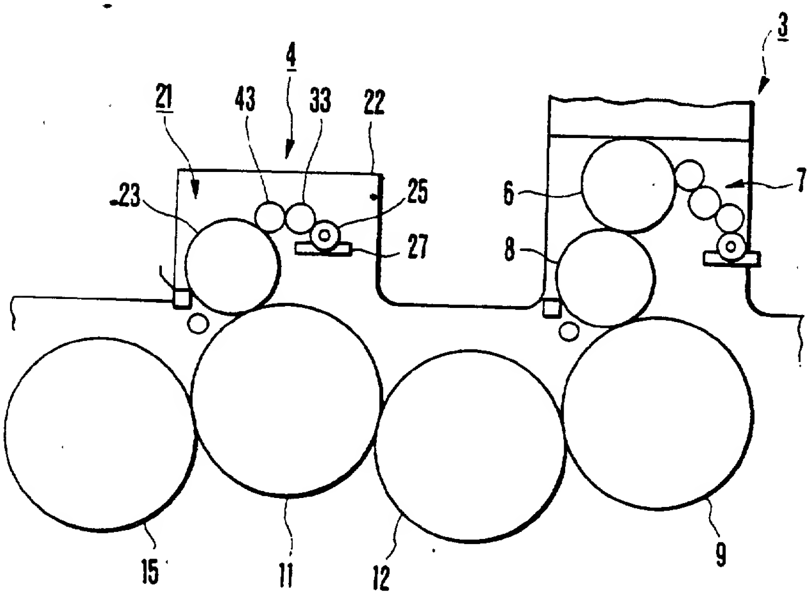
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FIG.3

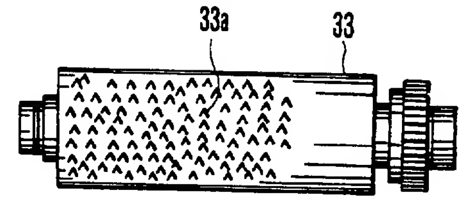

FIG.4

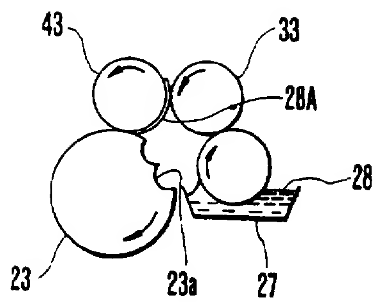

FIG.5(a)

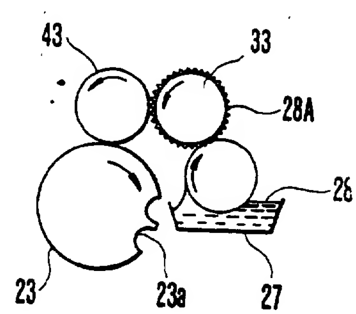

FIG.5(b)

VARNISHING APPARATUS FOR PRINTED SHEET

BACKGROUND OF THE INVENTION

The present invention relates to a varnishing apparatus, arranged between a printing unit and a delivery unit of a rotary press, or in an independent varnishing machine, for varnishing a printed surface of a paper sheet after printing.

A printed surface of a sheet printed by a rotary press is easily contaminated with ink in the following process since the ink dries slowly. In the case of sheets, offset occurs while they are stacked after a delivery operation. In order to prevent this, a drying device can be arranged midway along a conveying path of the printed sheet or spray powder can be sprayed at this position. However, the drying device makes the entire apparatus bulky. On the other hand, when powder is sprayed, the surface of the sheet is roughened causing it to lose its gloss and this often interferes with the following printing. Alternatively, varnish is coated on the printed surface to prevent it from being contaminated and to put a gloss thereon. This is performed mainly for catalogs, pamphlets, and the like, which must have a good appearance.

The varnishing apparatus of this type is sometimes used as an independent varnishing machine. However, in recent years, due to poor work efficiency caused by, e.g., re-stacking of sheets, the varnishing apparatus is normally arranged midway along a delivery path of a rotary press. A typical varnishing apparatus includes a roller group having a roller arrangement similar to that of a dampening device for supplying dampening water to the surface of a printing plate mounted on a plate cylinder of a rotary press. Varnish contained in a varnish duct is supplied to the surface of a rubber blanket cylinder through the roller group, and the varnish is transferred from the rubber blanket cylinder to a sheet passing between the rubber blanket cylinder and an impression cylinder.

However, the rubber blanket cylinder of varnishing apparatus of this type has a notch on its outer periphery portion and the notch corresponds to that for grippers of the impression cylinder. Therefore, a portion, which corresponds to the notch, of varnish to be transferred from the upstream form roller to the rubber blanket cylinder, cannot be transferred and is left on the peripheral surface of the form roller as a thick varnish film. The thick varnish film is moved to the effective surface of the rubber blanket cylinder upon the next rotation, and is then coated on a sheet. Therefore, the varnish film cannot be uniformly coated on the sheet surface between the gripper end and the sheet end, resulting in irregular density in the circumferential direction of a sheet and degrading a product quality.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide a varnishing apparatus which can form a uniform varnish film on a rubber blanket cylinder.

It is another object of the present invention to provide a varnishing apparatus which can supply an appropriate amount of varnish, so that a thick varnish film will not be left on a peripheral surface of a form roller.

In order to achieve the above objects, there is provided a varnishing apparatus for a printed sheet having: a metering roller, to a peripheral surface of which a varnish from a varnish duct is transferred a roller is brought into contact with a downstream side of the metering roller, and is rotated in the same direction as that of the metering roller to allow transfer of the varnish from the metering roller. A rubber blanket cylinder is brought into contact with a downstream side of the form roller and is rotated in a direction opposite to that of the form roller to allow transfer of the varnish from the form roller onto a peripheral surface thereof. The rubber blanket cylinder has a notch on its outer peripheral portion and transfers the varnish onto a sheet which is in contact with its peripheral surface, wherein a surface of the metering roller is formed of an elastic material having a roughened surface.

With the above arrangement, varnish transferred from a varnish duct to a metering roller is transferred to and coated on a sheet through a form roller and a rubber blanket cylinder, and varnish on the form roller facing the notch of the rubber blanket cylinder is not transferred to the rubber blanket cylinder and is left attached to the peripheral surface of the form roller to again face the peripheral surface of the metering roller. However, this varnish is pushed back and flattened by the roughened surface of the metering roller and is circulated while being held in the recessed portion of the roughened surface. Thus, almost no varnish is left on the form roller. Therefore, when the peripheral surface of the form roller faces the rubber blanket cylinder, almost no excess varnish will be transferred to the rubber blanket cylinder except for a normal transfer amount.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 to 5 show a varnishing apparatus for a printed sheet according to an embodiment of the present invention, in which:

FIG. 1 is a side view of the apparatus;

FIG. 2 is a schematic side view of a four-color sheet rotary press to which the apparatus of the present invention is applied;

FIG. 3 is an enlarged side view of the main part of FIG. 2;

FIG. 4 is a front view of a metering roller; and

FIGS. 5(*a*) and 5(*b*) are side views for explaining the operation of the rollers.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of the present invention will now be described with reference to the accompanying drawings.

Referring to FIG. 2, a rotary press 1 includes a sheet feeder 2, four-color printing units 3, a varnishing unit 4, and a delivery unit 5. These units are separately assembled and are then combined with each other. Each printing unit 3 has a plate cylinder 6 on the peripheral surface of which a printing plate is mounted, an inking device (not shown) for supplying ink to a printing surface, and a dampening unit 7 for supplying dampening water. The plate cylinder 6 abuts against a rubber blanket cylinder 8 to which an image formed on the plate surface with ink and dampening water is transferred. Each printing unit 3 has an impression cylinder 9 having a diameter twice that of the rubber blanket cylinder 8 to be in contact therewith. In addition, a transfer cylinder 10 having the same diameter as that of the impression cylinder 9 is arranged between adjacent impression

cylinders 9 to be in contact therewith. In the varnishing unit 4, an impression cylinder 11 having the same diameter as that of the impression cylinder 9 is arranged at the same level as that of the other impression cylinders. A transfer cylinder 12 is also arranged between the impression cylinder 11 and the impression cylinder 9 for the fourth color. Sheets 13 stacked on a sheet stacker of the sheet feeder 2 are picked up by a sucker device (not shown) one by one, and are fed to a feedboard 14. Thereafter, each sheet is gripped by grippers of the impression cylinder 9 for the first color through a swing device (not shown). During a sheet conveyance the sheet is alternatively gripped by the grippers of the transfer cylinder 10 and the impression cylinder 9, with the result that images of four colors are printed thereon as the sheet passes through each pair of the rubber blanket cylinders 8 and the impression cylinders 9. Then, the sheet is gripped by the grippers of the impression cylinder 11 of the varnishing unit 4 and is wound therearound. The delivery unit 5 includes a delivery cylinder 15 contacting the impression cylinder 11 and a pair of coaxial sprockets 16. A pair of endless delivery chains 19 having a large number of delivery grippers arranged at equal intervals in the direction of travel of the sheet are looped between the sprockets 16 and sprockets 18 at the front end portions of a pair of delivery frames 17. The sheet 13 gripped by the gripper of the impression cylinder 11 is then gripped and conveyed by the grippers of the chains 19 and is released therefrom at the conveying end to be dropped and stacked on a sheet stacker 20.

The varnishing unit 4 of the press 1 with the above arrangement includes a varnishing apparatus 21 described below. More specifically, a rubber blanket cylinder 23 which has the same diameter as that of the rubber blanket cylinder 8 and around which a blanket is wound is axially supported by right and left frames 22 through double-structured bearings (not shown). The rubber blanket cylinder 23 is coupled to a motor and is rotated in a direction indicated by arrow A in FIG. 1. The respective outer diameter central axes of double-structured bearings for axially supporting the rubber blanket cylinder 23 are eccentrical with that of the rubber blanket cylinder 23, as indicated by reference symbols t_1 and t_2. When the bearings are pivoted by an air cylinder an the like, the rubber blanket cylinder 23 can be brought into contact with or removed from the impression cylinder 11, and a contacting pressure between the impression cylinder 11 and rubber blanket cylinder 23 can be adjusted.

Bearings 24 supported to extend inward from the right and left frames 22 rotatably support the two ends of a shaft 26 of a duct roller 25. The duct roller 25 is dipped in a varnish 28 in a varnish duct 27 extending between the frames 22. The duct roller 25 is driven by motor (not shown) through gears and is rotated in a direction indicated by arrow B in FIG. 1. A pair of roller arms 29 are loosely mounted on the shaft portions of the bearings 24 between the end faces of the duct roller 25 and the frames 22. An inverted T-shaped arm 30 is swingably mounted on one free end portion of each roller arm 29 through a pin 31. A bearing 32 having an eccentrical bearing portion as indicated by reference symbol t_3 is fixed to one free end portion of each T-shaped arm 30 to allow pivot adjustment. The bearings 32 pivotally support a metering roller 33 so that the peripheral surface of the metering roller 33 abuts against that of the duct roller 25. The metering roller 33 is coupled to the duct roller 25 through gears (not shown), and is rotated in a direction indicated by arrow C in FIG. 1. In addition, when the bearings are pivoted by loosening bolts, a nip pressure between the duct roller 25 and metering roller 33 can be adjusted. One roller arm 29 and one T-shaped arm 30 are coupled to each other through a lever 34 having an eccentrical portion indicated by reference symbol t_4 at its one end. When a pin 35 arranged at the eccentrical portion of the lever 34 is manually pivoted, the metering roller 33 can be brought into contact with or removed from the duct roller 25.

A surface portion 33*a* of the metering roller 33 is formed of an elastic material, e.g., synthetic rubber having a hardness of 20° or higher where "°" indicates the conventional JIS standard for hardness, and a hydrophilic and a hydrophi-lic property. The surface of the elastic material is roughened by a rotary grinder or a buff for grinding. The roughness of the roughened surface 33*a* is set to be 50 to 500% mesh in this embodiment that is, a surface roughness corresponding to a mesh of 50 to 500 lines per inch.

A cam 36 has a large diameter portion 36*a* and a small diameter portion 36*b*, and is fixed to a cam shaft 37 extending between the frames 22. The cam surface of the cam 36 is brought into contact with a roller 38 which is pivotally mounted on the free end portion of each T-shaped arm 30 to allow eccentricity adjustment, as indicated by reference symbol t_5. A stud 39 projecting from each frame 22 axially supports a spring shaft 40 which is capable of pivot adjustment and one end of which is pivotally mounted on the T-shaped arm 30. The T-shaped arm 30 receives a pivoting force from a compression coil spring 41 on the spring shaft 40 for pressing the roller 38 against the cam surface of the cam 36. When the cam shaft 37 is pivoted by an air cylinder (not shown), the metering roller 33 is brought into contact with or removed from the duct roller 25 through the cam 36, the roller 38, and the T-shaped arm 30.

An eccentric bearing 42 in which an outer diameter central axis is eccentric from the inner diameter central axis as indicated by reference symbol t_6 is arranged above the rubber blanket cylinder 23 to be axially supported by the frames 22. The eccentric bearing 42 axially supports a form roller 43 so that the peripheral surface of the form roller 43 is brought into contact with that of the rubber blanket cylinder 23. When the eccentric bearing 42 is pivoted by an air cylinder (not shown), the form roller 43 is brought into contact with or removed from the rubber blanket cylinder 23. The form roller 43 is coupled to the motor for driving the duct roller 25 through a one-way clutch and gears (neither of which are shown). The form roller 43 can be driven only by the motor to be rotated in a direction indicated by arrow D in FIG. 1.

The operation of the varnishing apparatus 21 with the above arrangement will now be described. When a varnishing operation is performed, the motor for driving the duct roller 25 is started in an impression throw-off state, and the cam 36 is pivoted by the air cylinder. Thus, the roller 38 faces the small diameter portion 36*b* of the cam 36, and the metering roller 33 is pressed against the duct roller 25 and the form roller 43 by the biasing force of the compression coil spring 41. At this time, since the eccentric bearing 42 is pivoted, the form roller 43 is located at a contact position. However, the rubber blanket cylinder 23 is located at its non-contact

position upon pivotal movement of its bearing. Therefore, the form roller 43 is separated from the rubber blanket cylinder 23. Rotation of the motor is transmitted to the duct roller 25 and the metering roller 33 through the gears, and is also transmitted to the form roller 43 through the one-way clutch and the gears. Note that the rubber blanket cylinder 23 is separated apart from the impression cylinder 11 and is stopped.

When the respective rollers are rotated, the varnish 28 in the varnish duct 27 is picked up by the duct roller 25, and is transferred to the metering roller 33 while its film thickness is adjusted by the contacting force of the metering roller 43. Thereafter, the varnish 28 is transferred to the form roller 33 and is then circulated between the metering roller 33 and duct roller 25.

When the press is rotated to feed the sheet 13 onto the feedboard 14 by the sheet feeder 2, the sheet 13 is conveyed, and the rubber blanket cylinder 8 of the printing units 3 is thrown on, thus performing four-color printing between the rubber blanket cylinders 8 and the impression cylinders 9. Thereafter, the sheet 13 is conveyed toward the varnishing unit 4. When the sheet 13 reaches the varnishing unit 4, the bearing is pivoted upon instruction from a timing generator to throw on the rubber blanket cylinder 23, so that the rubber blanket cylinder 23 is pressed against the impression cylinder 11 and the form roller 43. Therefore, the varnish circulating between the form roller 43 and duct roller 25 is transferred to the rubber blanket cylinder 23, and is transferred to and coated on the sheet 13 fed between the rubber blanket cylinder 23 and the impression cylinder 11. The varnished sheet 13 is conveyed by the delivery chains 19, and is stacked on the sheet stacker 20. In the impression throw-on state of the rubber blanket cylinder 23, rotation of the motor is kept transmitted to the form roller 43 through the one-way clutch, and the rotation of the rubber blanket cylinder 23 is also transmitted to the form roller 43 through the gears and the other one-way clutch upon throwing-on of the rubber blanket cylinder 23. In this case, since the rotating speed of the rubber blanket cylinder 23 is higher than that of the motor, the rotation is transmitted only by one one-way clutch, and the other one-way clutch is rotated idle.

After the varnishing operation, the sheet-feed operation is stopped, so that the sheet stacker 20 of the delivery unit 5 is exchanged for an empty one, or a paper size is changed, or the blanket is adjusted. Then, the rubber blanket cylinder 8 of the printing units 3 is thrown off and, at the same time, the rubber blanket cylinder 23 of the varnishing apparatus 21 is thrown off with respect to the impression cylinder 11 and the form roller 43. At this time, although the metering roller 33 is kept rotated so as not to solidify the varnish, the explanation of this operation is omitted.

After the above operation or adjustment, the sheet-feed operation is restarted. When the sheet 13 reaches the rubber blanket cylinder 23, the air cylinder is operated at a predetermined timing upon instruction from the timing generator. Then, the roller 38 is pressed against the large diameter portion 36*a* of the cam 36, and the rubber blanket cylinder 23 is thrown on. Therefore, the form roller 43 is urged against the rubber blanket cylinder 23 at a contacting pressure determined by the cam 36 and the roller 38, and is recovered to a varnishing state before the sheet-feed operation is stopped.

In the varnishing apparatus 21 operated as described above, a notch 23*a* as an ineffective portion corresponding to each of the notches for the grippers of the impression cylinder 11 is formed on the outer peripheral surface of the rubber blanket cylinder 23, as shown in FIG. 5(*a*). By the way, the impression cylinder is twice as large in diameter as the blanket cylinder and is provided with two notches located at diametrically opposite positions. When the rubber blanket cylinder 23 and the form roller 43 are rotated in the directions respectively indicated by arrows A and D, the varnish corresponding to the notch 23*a* is mixed with a new varnish film without being transferred to the rubber blanket cylinder 23 and becomes a thick varnish film 28A. Thus, the varnish film 28A is left on the form roller 43 and passes through the contacting point with the metering roller 33. In this case, in the conventional apparatus described previously, the thick varnish film 28A is left on the form roller 43 and is then transferred to the peripheral surface of the rubber blanket cylinder 23 during the next rotation, thus causing uneven coating. However, in the apparatus of this embodiment, the metering roller 33 and the form roller 43 are rotated in the same direction, and the surface portion 33*a* of the metering roller 33 is roughened, as shown in FIGS. 4 and 5(*b*). Therefore, the thick varnish film 28A to be left on the form roller 43 is pushed backward and flattened by the roughened surface portion 33*a* of the metering roller 33 which is circulated while being in sliding contact with the form roller 43. In addition, since the varnish becomes attached to the metering roller 33 to be held in the recess portion of the roughened surface, it will not be left on the form roller 43. The varnish film 28A returned to the metering roller 33 merges with the varnish 28 picked up by the duct roller 25 and the film thickness is adjusted by the nip pressure therebetween.

Note that the number of rollers and the arrangement thereof are not limited to those in the above embodiment. The metering roller, the form roller, and the rubber blanket cylinder need only be brought into contact with each other in this order from the upstream side, and the number of other rollers and the arrangement thereof can be desirably determined. In the above embodiment, the case has been exemplified wherein the varnishing apparatus is installed in the four-color press. However, the present invention can be applied to any color press or can be independently used.

According to the present invention as described above, in a varnishing apparatus for a printed sheet, a metering roller, a form roller, and a rubber blanket cylinder having a notch on its outer peripheral surface are arranged in this order from a varnish duct, so that their outer peripheral surfaces are brought into contact with each other. The form roller and the rubber blanket cylinder are rotated in opposite directions to sequentially transfer a varnish from the varnish duct. Thereafter, the varnish is transferred to and coated on a sheet contacting the rubber blanket cylinder. Since the surface portion of the metering roller is formed by an elastic material having a roughened surface, when the varnish is transferred between the form roller and the rubber blanket cylinder, the varnish corresponding to the notch of the rubber blanket cylinder is left on the form roller without being transferred to the rubber blanket cylinder. Therefore, even if the varnish left on the form roller is circulated toward the contacting point with the metering roller, it is flattened and pushed back by the metering roller having the roughened peripheral surface and is held in the recess portion of the roughened surface to be left on the metering roller. Therefore,

since virtually no varnish is left on the form roller and a fresh film of varnish is supplied to the form roller from the metering roller, uneven coating will not occur on the varnished surface of a printed sheet. In addition, since the varnish can be coated uniformly, product quality of the printed sheet can be greatly improved.

What is claimed is:

1. A varnishing apparatus for a printed sheet comprising:

a varnish duct for containing a varnish;

a metering roller having a roughened peripheral surface portion roughened peripheral surface portion being formed of an elastic material;

transfer means located between said varnish duct and said metering roller for selectively transferring said varnish from said varnish duct to said roughened peripheral surface portion of said metering roller;

a form roller which is selectively in contact with said metering roller, said form roller having a peripheral outer surface, said form roller being rotated in said first direction to allow transfer of said varnish from said roughened peripheral surface of said metering roller to said peripheral outer surface of said form roller;

a rubber blanket cylinder which is selectively in contact with said peripheral outer surface of said form roller, said rubber blanket cylinder having an outer peripheral surface, said rubber blanket cylinder being rotated in a direction opposite said first direction to allow transfer of said varnish from said peripheral outer surface of said form roller onto said outer peripheral surface of said rubber blanket cylinder, said rubber blanket cylinder transferring said varnish onto said printed sheet when said printed sheet is in selective contact with said outer peripheral surface of said rubber blanket cylinder;

means adjacent said metering roller for rotating said metering roller;

means adjacent said form roller for rotating said form roller; and

means adjacent said rubber blanket cylinder for rotating said rubber blanket cylinder.

2. An apparatus according to claim 1, wherein said elastic material is synthetic rubber having a hardness of not less than 20° and a hydrophilic property.

3. An apparatus according to claim 1, wherein said roughened peripheral surface of said metering roller is formed by a rotary grinder disk.

4. An apparatus according to claim 3, wherein said roughened peripheral surface of said metering roller has a roughness of 50 to 500 lines per inch.

5. An apparatus according to claim 4, wherein said varnishing apparatus is connected to a four-color rotary press and said printed sheet is provided by said four-color rotary press.

6. An apparatus according to claim 1, wherein said roughened peripheral surface is formed by buffing.

7. An apparatus according to claim 1, wherein said means for rotating said metering roller includes means for selectively transferring said varnish from said peripheral outer surface of said form roller to said outer peripheral surface of said rubber blanket cylinder.

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United States Patent [19]

Bruno

[11] **Patent Number: 4,821,672**

[45] **Date of Patent: Apr. 18, 1989**

[54] **DOCTOR BLADE ASSEMBLY WITH ROTARY END SEALS AND INTERCHANGEABLE HEADS**

[76] Inventor: **Nick Bruno**, 574 Marina Blvd., San Leandro, Calif. 94577

[21] Appl. No.: **64,676**

[22] Filed: **Jun. 22, 1987**

[51] **Int. Cl.**[4] **B05C 1/08**

[52] **U.S. Cl.** **118/261**; 101/169; 101/366; 118/259; 118/413

[58] **Field of Search** 118/261, 259, 413; 101/366, 169

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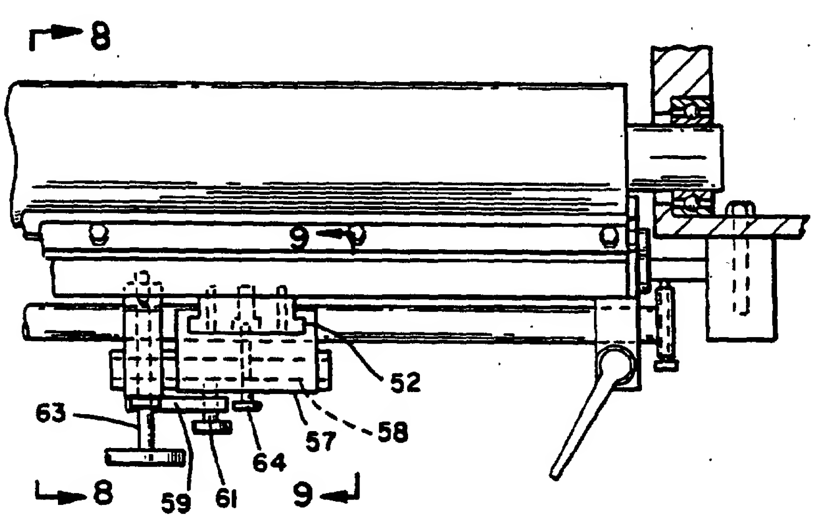
Primary Examiner—Stanley Silverman

Attorney, Agent, or Firm—Harris Zimmerman; Howard Cohen

[57] **ABSTRACT**

A doctor blade assembly adapted for applying liquid uniformly to a rotating transfer roller includes an applicator head having a channel-like cavity extending longitudinally parallel to the transfer roller axis. A pair of doctor blades extend obliquely from the longitudinal edges of the channel to impinge on the circumferential surface of the transfer roller. The blades each may be secured by longitudinally spaced screws, or by a blade holder secured to a longitudinal piano hinge and spring biased to clamp the respective blade. A pair of rotary end seals are joined to the opposed ends of the channel to form a sealed chamber against the transfer roller. Each end seal includes an end plate resiliently impinging on the end surface of the transfer roller, and a seal member secured to the end plate and disposed to engage the endmost portion of the circumferential roller surface. A plurality of mounting lugs extend outwardly from the applicator head, each lug including a stepped, semi-cylindrical portion. A like plurality of mounting blocks are secured to support arms extending from a pivot shaft that is parallel to the axis of the transfer roller, each mounting block having a slot dimensioned to receive one of the mounting lugs in precision fit. Mounting screws extend from the support arms and mounting block to the applicator head. A plurality of applicator heads are provided, all with the same mounting lug spacing, so that applicator heads may be interchanged quickly by rotating the pivot shaft away from the transfer roller, sliding the lugs out of the mounting block slots, inserting the lugs of a replacement head into the mounting block slots, tightening the mounting screws, and rotating the shaft to move the replacement head into impingement with the transfer roller.

15 Claims, 4 Drawing Sheets



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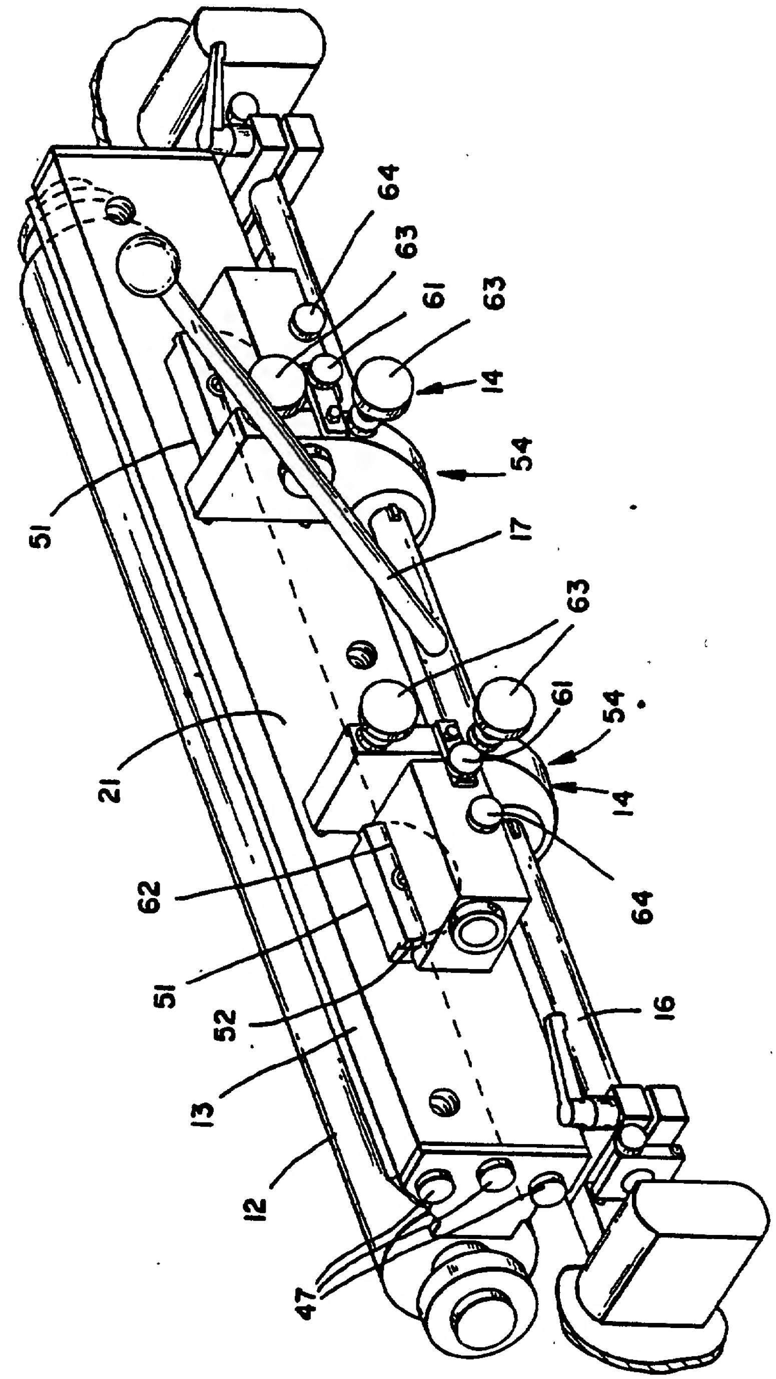


FIG — 1

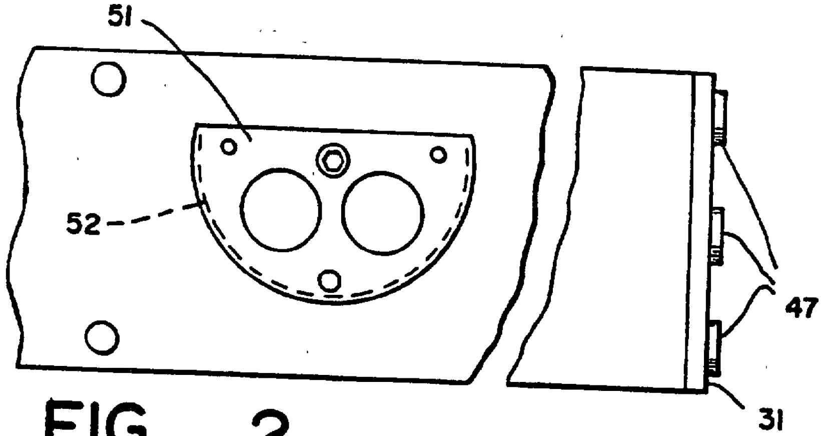


FIG _ 2

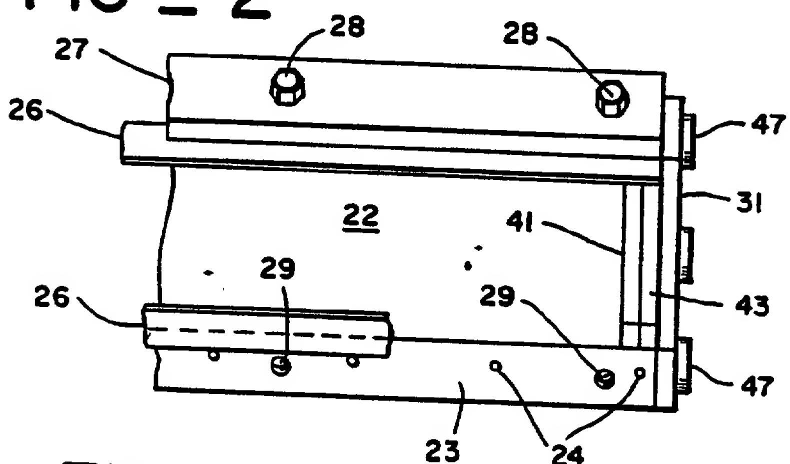
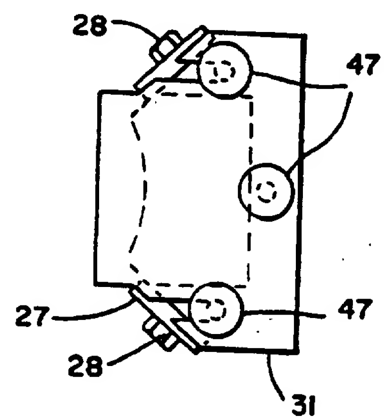


FIG _ 3

FIG _ 4



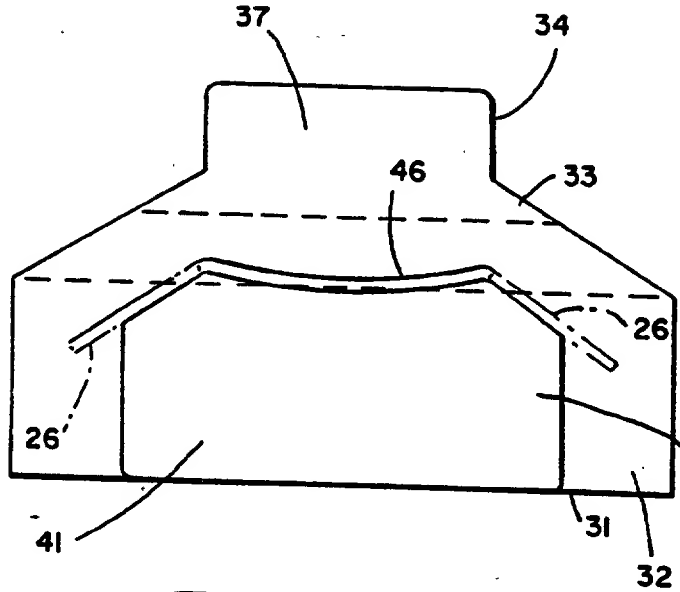


FIG _ 5

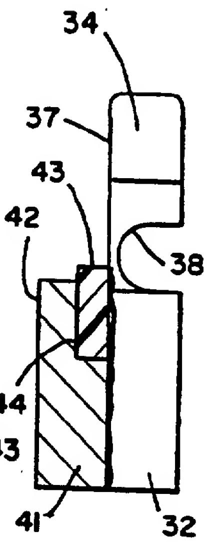


FIG _ 6

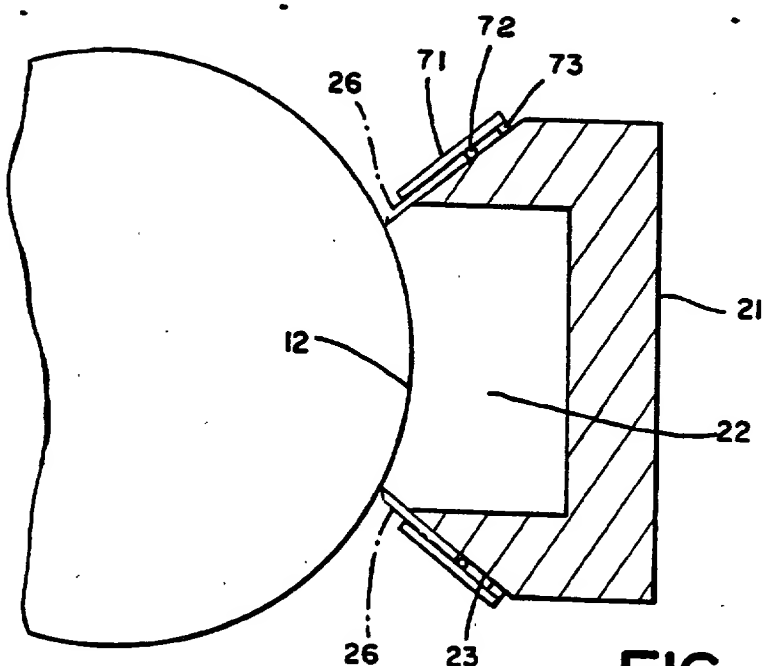


FIG _ 11

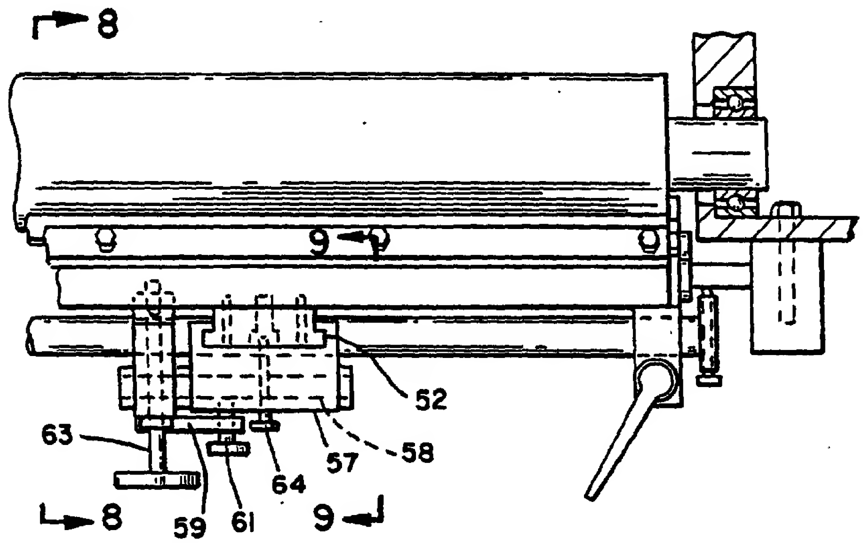


FIG _ 7

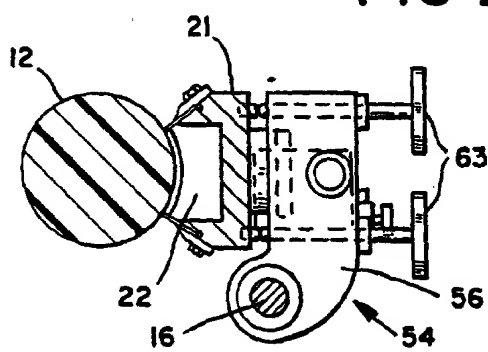


FIG _ 8

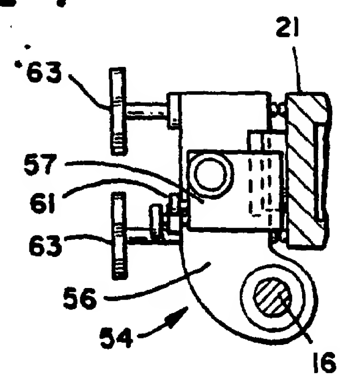


FIG _ 9

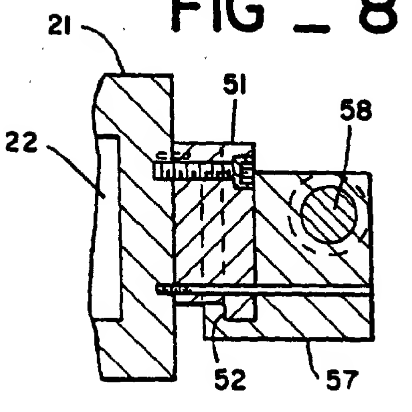


FIG _ 10

DOCTOR BLADE ASSEMBLY WITH ROTARY END SEALS AND INTERCHANGEABLE HEADS

BACKGROUND OF THE INVENTION

In the application of liquid substances to a moving web of material, it is considered well known in the art to apply the liquid using a rotating transfer roller, and to directly apply the liquid uniformly onto the roller by means of a doctor blade assembly. The doctor blade assembly generally includes a reservoir chamber extending the length of the transfer roller and in contact with the circumferential surface thereof, and a pair of doctor blades extending longitudinally on either side of the chamber. The doctor blades are angled obliquely toward the transfer roller surface, and serve both to seal the reservoir chamber to the roller and to form a uniform film of liquid on the roller transfer surface. The assembly also must include some means to seal the reservoir chamber at the ends of the roller, so that the liquid is not flung from the roller into the surroundings, and so that the the liquid may be pumped through the reservoir during the transfer process. Such transfer systems are used in flexographic and gravure printing, adhesive applicators in the paper converting industry, coating applicators in many different industrial processes, and the like.

A persistent problem in prior art transfer systems is the sealing arrangement with the transfer roller. It may be appreciated that the transfer roller operates at high speed, on the order of 1000 linear feet per minute, and the end seals of the doctor blade assembly wear quickly. As the end seals wear, the applied liquid is flung from the transfer roller, causing a difficult and messy cleanup problem. Furthermore, the doctor blades themselves must be aligned with the roller with extreme precision, with tolerances to one thousandth of an inch. These two factors combine synergistically to reduce the productivity of the transfer system. That is, when the end seals or the doctor blades are too worn to be used further, the system must be shut down, the head must be removed, and the end seals replaced. Likewise, changing ink color in a printing press also requires removal and replacement of the doctor blade head. When the head is resecured to the transfer roller assembly, it must be carefully aligned to the transfer roller so that the liquid is once again uniformly applied to the roller and to the moving web of material. The steps of rebuilding or replacing the end seals and re-aligning the doctor blade head result in an unacceptable amount of down time for the transfer system. Clearly the prior art indicates the need for a system which reduces the time required to rebuild the end seals and re-align the head.

One approach known in the prior art provides a pair of stationary end seal members impinging on the ends of the transfer roller, so that the doctor blade head may form a seal with the stationary seals rather than with the moving surface of the transfer roller. This sealing arrangement requires sealing hardware to be mounted on the transfer roller and machine frames which is more cumbersome and costly. This system also does not incorporate a feature to easily remove and replace the doctor blade head.

SUMMARY OF THE PRESENT INVENTION

The present invention generally comprises a doctor blade system for transfer roller applicators that overcomes the serious drawbacks in the prior art noted above. One salient feature of the invention is the provision of a doctor blade mounting system that permits the quick change of interchangeable doctor blade heads, so that as the doctor blades wear out, the doctor blade head may be replaced within seconds by a fresh doctor blade head. Likewise, changing of ink color on a printing press may be accomplished with very little down time by using interchangeable doctor blade heads.

Furthermore, the mounting system of the invention is designed to align the interchangeable doctor blade heads with a precision and repeatability unknown in the prior art, so that setup time and downtime are virtually eliminated.

The doctor blade assembly adapted for applying liquid uniformly to a rotating transfer roller includes an applicator head having a channel-like cavity extending longitudinally parallel to the transfer roller axis. A pair of doctor blades extend obliquely from the longitudinal edges of the channel to impinge on the circumferential surface of the transfer roller. The blades each may be secured either by longitudinally spaced screws, or, in an alternative embodiment, by a blade holder secured to a longitudinal piano hinge and spring biased to clamp the respective blade.

The invention includes pair of rotary end seals joined to the opposed ends of the channel to form a sealed engagement against the moving surface of the transfer roller. Each end seal includes an end plate resiliently impinging on the end surface of the transfer roller, and a seal member secured between the end plate and the end of the channel member and disposed to engage the endmost portion of the circumferential roller surface. The seal members are easily replaced by quick removal of the end plates an substitution of new seal members.

The quick change mounting feature includes a plurality of mounting lugs extending outwardly from the outer longitudinal surface of the applicator head, each lug including a stepped, semi-cylindrical portion. A like plurality of mounting blocks are secured to a pivot shaft extending parallel to the axis of the transfer roller, each mounting block having a slot dimensioned to receive one of the mounting lugs in precision fit, in the manner of a Woodruff key arrangement. At least two applicator heads are provided, with the same precision mounting lug spacing, so that applicator heads may be interchanged quickly by rotating the pivot shaft away from the transfer roller, sliding the lugs out of the mounting block slots, inserting the lugs of a replacement head into the mounting block slots, and rotating the shaft to move the replacement head into impingement with the transfer roller. The mounting blocks are provided with vernier adjustment mechanisms to facilitate alignment of the heads with the transfer roller; however, after the system is set up, heads may be interchanged with little or no readjustment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the doctor blade system of the present invention, shown engaged with a typical prior art transfer roller.

FIG. 2 is a partial elevation of the outer longitudinal surface of the doctor blade head of the present invention, showing in particular a mounting lug thereof.

FIG. 3 is a partial plan view of the doctor blade head, showing the liquid chamber and the doctor blades.

FIG. 4 is an end elevation of the end plate of the seal assembly of the present invention.

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FIG. 5 is an enlarged inside end view of the seal assembly of the present invention.

FIG. 6 is a partially sectioned side view of the end seal assembly as shown in FIG. 5.

FIG. 7 is a partial top view of the doctor blade system of the present invention, shown engaged with a typical transfer roller.

FIG. 8 is a cross-sectional elevation of the doctor blade system, taken along line 8—8 of FIG. 7.

FIG. 9 is a partial cross-sectional elevation of the doctor blade system, taken along line 9—9 of FIG. 7.

FIG. 10 is a cross-sectional elevation of the mounting block-mounting lug engagement of the doctor blade system of the present invention.

FIG. 11 is a cross-sectional end view of a further embodiment of the invention for mounting the doctor blades on the applicator head.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention generally comprises an improved doctor blade assembly for use in applying liquids in general to a transfer roller, such as in printing presses, adhesive applicators, coating machines, and the like. With regard to FIG. 1, a typical transfer roller 12 is shown, the roller being adapted to apply liquid either to a printing drum or to apply liquid directly to a moving web of material, as is known in the prior art. The liquid is supplied to the roller 12 by a doctor blade applicator head 13 which is secured by a mounting arrangement 14 to a pivot shaft 16 extending parallel to the axis of rotation of the transfer roller. A handle 17 extends from the pivot shaft 16 to facilitate rotation of the shaft 16 and movement of the head 13 into and out of engagement with the transfer roller.

The primary structural component of the head 13 is a channel-like member 21, shown particularly in FIGS. 3 and 8. The member 21 includes an open-ended channel cavity 22 extending longitudinally therein, and the longitudinally extending sides 23 of the member 21 are sloped obliquely in outwardly converging fashion. A plurality of locating pins 24 are spaced along the surfaces 23 to provide alignment for a pair of doctor blades 26, as shown in FIG. 3. A pair of blade covers 27 are also provided, each disposed atop one of the blades 26 and secured by screws 28 extending into tapped holes 29 extending into the respective surfaces 23. The blades 26 are aligned precisely by the pins 24 to be parallel to each other and to the axis of the cavity 22. The confronting edges of the blades extend beyond their respective blade covers to impinge on the circumferential surface of the transfer roller, as shown in FIG. 8.

The doctor blade applicator head 13 also includes a pair of end seal assemblies adapted to seal the open ends of the channel cavity 22 and to engage the rotating transfer roller in sealing fashion. As shown in FIGS. 5 and 6 in particular, each end seal assembly includes an end plate 31 formed of a resilient, durable polymer such as Delrin TM or the like. Each end plate 31 includes a generally retangular base portion 32, a medial portion 33 having tapering, converging sides, and an upper tab-like portion 34. The medial and upper portions 33 and 34 include a continuous surface 37 which js adapted to impinge directly on the end surface of the transfer roller, as shown for example in FIG. 7. To enhance the resilient impingement on the roller end surface, the medial portion of the end plate is provided with a deep groove 38 extending laterally in the end plate surface opposite the surface 37. The groove 38 permits increased flexure of the portion impinging on the transfer roller, and aids in forming a seal between the surface 37 and the end of the transfer roller. The spacing of the confronting surfaces 37 of the two end plates is slightly less than the length of the transfer roller, so that the end plates impinge on the ends of the roller sufficiently tightly to prevent any significant slinging of liquid from the ends of the transfer roller.

The end seal also includes an inner end plate 41 secured to the respective end surface of the channel member. It may be appreciated that the base portion 32 of the end plate 31 is sufficiently wide to span the end of the channel member 21, and that the inner plate 41 includes an inset portion dimensionsed to fit within the channel cavity 22 in close fit. The end plate 31 and 41 thus serve to close the open ends of the channel cavity in liquidretaining fashion. In addition, the inner plate 41 includes a tab portion 42 extending upwardly therefrom to define an interior pocket 44 between it and the confronting end plate surface. A soft, resilient seal member 43 is secured within the pocket 44. The tab portion 42 includes an arcuate upper surface, and the upper surface of the seal member 43 is likewise provided with an arcuate upper surface 46 spaced upwardly from the tab portion. The surface 46 is curved to conform to the circumferential surface of the transfer roller 12, and is disposed to impinge on the endmost portion of the circumferential surface in sealing fashion.

It should be noted that the doctor blade head 13 is designed to engage the transfer roller in a sealed fashion. That is, the doctor blades engage the entirety of the generally smooth surface of the transfer roller and permit only a thin film of liquid to discharge from the cavity 22 to the transfer roller. The end seal assembly seals the open ends of the channel cavity, and also forms a seal between the ends of the doctor blade assembly and the ends of the transfer roller. Thus the channel cavity 22 is sealed as a closed chamber with the transfer roller, and this closed chamber retains a reservoir of liquid to be applied to the roller. Indeed, the head 13 also includes means (not shown) for circulating a liquid, such as printing ink or bonding adhesive, through the chamber, so that the liquid remains constant in viscosity and uniform in composition.

The seal member 43, although being formed of soft resilient rubber material or the like, is able to withstand rapid wear against the rapidly rotating roller surface. To facilitate the removal and replacement of the seal member 43, the end plates 31 are secured to the ends of the member 21 by means of a plurality of screws 47 having knob ends for easy manipulation without special tools, as shown in FIGS. 2-4.

As noted in the foregoing, an important aspect of the present invention is the provision of interchangeable doctor blade heads 13, and a mounting system 14 that permits the quick exchange of heads and realignment of a replacement head with the transfer roller. With regard to FIGS. 1 and 2, each head 13 is provided with a pair of mounting lugs 51 spaced longitudinally, all of the interchangeable heads having the same lugs 51 disposed precisely at the same spacing and location. The lugs 51, which extend from the outer longitudinal surface of the head, are shaped as sections of a cylinder extending orthogonally from the head each section comprising slightly more than 180° of the cylinder. In addition, the outer end of each lug is provided wih a flange 52 ex-

tending radially outwardly from the cylinder in stepped fashion, as shown in FIGS. 1, 7, and 10.

The mounting arrangement 14 also includes a pair of support arm assemblies 54, each joined to the pivot shaft 16 and rigidly affixed thereto in precise alignment parallel to each other. The support arm assemblies are formed as identical, mirror image assemblies so that the description of one will suffice for both. With regard to FIGS. 1 and 7-10, each assembly 54 includes a support arm 56 formed in dogleg fashion, the offset end of the arm provided with a hole through which the shaft 16 is received and keyed. A mounting block 57 is joined to the support arm by means of a stub shaft 58, so that the mounting block may be pivoted about an axis that is parallel to the axes of the shaft 16 and the transfer roller 12. A bar 59 extends from the support arm adjacent to the mounting block 57, and an angle setting screw 61 extends from the bar 59 to be received in a tapped hole in the mounting block. It may be appreciated that, due to the offset between the screw and the shaft 58, the knob head of the screw may be turned to selectively limit the range of angles or repose of the mounting block with respect to the support arm when a doctor blade head is not secured to the mounting block.

Each mounting block is provided with an slot 62 extending into the upper surface thereof and having a stepped, semi-cylindrical conformation complementary to one of the mounting lugs 51. Each support arm further includes a pair of mounting screws 63 extending therethrough and aligned to impinge on hardened buttons extending from the outer surface of the head 13. The screws 63 thus set the angle of the head with respect to the support arm. A further set screw 64 extends from the outer surface of the mounting block to the slot 62, and is disposed to be received in a tapped hole provided in the mounting lug 51, as shown in FIG. 7.

It may be appreciated that the handle 17 may be employed to rotate the shaft 16 and swing the doctor blade head 13 away from the transfer roller 12, and that the head may easily be removed from the mounting blocks by releasing the screws 64, and lifting the head to remove the mounting lugs from the mounting slots 62. To replace the removed head, a further head 12 is secured by first placing its mounting lugs 51 into the slots 62 of the mounting blocks, thereby automatically aligning all the relevant screw holes. The screws 64 are then tightened into the mounting lugs, and the screws 63 maintain the requisite setup angle of the replacement head. It should be noted that the screws 63 and 64 include lock nuts which aid in setting the position of the doctor blade head, and which remain fixed once the setup is perfected. The new head is thereby aligned with the mounting blocks precisely in the position of the removed head. The handle 17 then is rotated to swing the new head into engagement with the transfer roller. A stop on the shaft 16 (not shown) limits the head movement toward and away from the transfer roller.

The angle adjustment control screw 61 is employed for setup purposes to hold the mounting blocks in position to receive a doctor blade head. Due to precise machining and placement of the mounting lugs and screws, the angle adjustment set by the screws 63 should not require any modification during replacement of the doctor blade heads. The quick change capability and interchangeability of the heads, together with the accurate repeatability of placement of the heads, virtually eliminates downtime for the transfer roller system. Furthermore, the end seals are adapted to be disassembled and replaced quickly, and this task may be accomplished off-line while the transfer roller system continues to operate.

A further embodiment of the invention, shown in FIG. 11, discloses another system for securing the doctor blades 26 to the surfaces 23 of the member 21. A pair of piano hinges 71 are each secured longitudinally along the entire length of one of the surfaces 23, and a blade cover 72 is secured to each of the piano hinges. A plurality of coil springs 73 are secured in recesses spaced along each surface 23, and disposed to expand against one edge of the respective blade cover 72 and drive the blade cover to clamp the blade 26 against the surface 23. This system permits quicker removal and replacement of the doctor blades, which are also subject to wear and require periodic maintenance.

I claim:

1. A doctor blade assembly adapted for applying a liquid uniformly to a rotating transfer roller, comprising;

a longitudinally extending doctor blade head having a channel-like cavity formed therein and oriented parallel to the transfer roller, a pair of doctor blades disposed on opposed sides of said cavity and extending the length thereof and adapted to impinge on the transfer roller,

said pair of doctor blades extending parallel to the transfer roller and converging as they extend from said opposed sides of said cavity toward the transfer roller,

a pair of end seal assemblies secured to said doctor blade head and disposed at opposite ends of said cavity, each end seal assembly including means for establishing a high pressure liquid seal with a rotating peripheral surface portion of the transfer roller at a respective end of the transfer roller, and

means for supporting said doctor blade head and removably positioning said doctor blade head so that said doctor blades may be moved into and out of engagement with the transfer roller.

2. The doctor blade assembly of claim 1, further including a plurality of said doctor blade heads, said means for supporting said doctor blade head including means for interchangeably removing and securing any one of said plurality of doctor blade heads in substantially identical alignment with respect to the transfer roller.

3. The doctor blade assembly of claim 2, wherein said means for supporting said doctor blade heads include a plurality of mounting lugs extending from each of said doctor blade heads, a like plurality of mounting blocks, a plurality of slots, each extending into one of said mounting blocks and dimensioned to receive one of said mounting lugs in close fit, and support arm means connected to said mounting blocks.

4. The doctor blade assembly of claim 3, wherein said support arm means includes a pivot shaft extending generally parallel to the transfer roller, and a like plurality of support arms extending fixedly from said pivot shaft in parallel alignment each to the other.

5. A doctor blade assembly adapted for applying a liquid uniformly to a rotating transfer roller, comprising;

a longitudinally extending doctor blade head having a channel-like cavity formed therein and oriented parallel to the transfer roller, a pair of doctor blades disposed on opposed sides of said cavity and

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extending the length thereof and adapted to impinge on the transfer roller,

a pair of end seal assemblies secured to said doctor blade head and disposed at opposite ends of said cavity, each end seal assembly including means for establishing a liquid seal with a rotating peripheral surface portion of the transfer roller at a respective end of a transfer roller,

means for supporting said doctor blade head and removably positioning said doctor blade head so that said doctor blades may be moved into and out of engagement with the transfer roller,

a plurality of said doctor blade heads, said means for supporting said doctor blade head including means for interchangeably removing and securing any one of said plurality of doctor blade heads in substantially identical alignment with respect to the transfer roller,

said means for supporting said doctor blade heads including a plurality of mounting lugs extending from each of said doctor blade heads, a like plurality of mounting blocks, a plurality of slots, each extending into one of said mounting blocks and dimensioned to receive one of said mounting lugs in close fit, and support arm means connected to said mounting blocks,

said support arm means including a pivot shaft extending generally parallel to the transfer roller, and a like plurality of support arms extending fixedly from said pivot shaft in parallel alignment each to the other, and

means for joining each of said mounting blocks to one of said support arms, including a stub shaft extending from each of said support arms and pivotally received in a respective mounting block, said stub shaft extending generally parallel to said pivot shaft and said transfer roller.

6. The doctor blade assembly of claim 5, further including adjustment means for selectively setting the angular disposition of each of said mounting blocks about the respective stub shaft.

7. The doctor blade assembly of claim 5, further including a plurality of mounting screws extending from each of said support arms and adapted to impinge on hardened buttons extending from an outer surface of each of said doctor blade heads.

8. The doctor blade assembly of claim 1, wherein said end seal assemblies each include an end plate removably secured to a longitudinally opposed end of said doctor blade head and having a proximal end portion dimensioned to extend across one end of said channel-like cavity in sealing fashion, said end plate further including a distal end portion disposed to impinge on the end surface of the transfer roller.

9. The doctor blade assembly of claim 8, wherein each of said end seal assemblies further includes a resilient seal member secured to said end plate, said resilient seal member including a distal surface disposed to impinge on a rotating circumferential portion of the transfer roller.

10. The doctor blade assembly of claim 9, wherein said distal surface of said resilient seal member is provided with an arcuate conformation complementary to the curvature of the transfer roller.

11. The doctor blade assembly of claim 9, wherein each of said end seal assemblies further includes an inner plate secured to said end plate and disposed to retain said resilient seal member therebetween.

12. The doctor blade assembly of claim 1, further including means for removably securing said pair of doctor blades to said head, including a pair of longitudinally disposed oblique surfaces extending along opposed sides of said channel-like cavity, a plurality of locating pins spaced along each of said oblique surfaces, and a pair of blade covers, each disposed to be removably secured to one of said oblique surfaces and to clamp a respective one of said doctor blades therebetween.

13. The doctor blade assembly of claim 1, further including means for removably securing said pair of doctor blades to said head, including a pair of longitudinally disposed oblique surfaces extending along opposed sides of said channel-like cavity, a pair of piano hinges, each extending substantially the length of one of said oblique surfaces, a pair of blade cover members, each secured to one of said piano hinges, and resilient means for biasing each of said blade cover members to rotate and impinge on the respective oblique surface and clamp one of said doctor blades therebetween.

14. A doctor blade assembly adapted for applying a liquid uniformly to a rotating transfer roller, comprising;

a longitudinally extending doctor blade head having a channel-like cavity formed therein and oriented parallel to the transfer roller, a pair of doctor blades disposed on opposed sides of said cavity and extending the length thereof and adapted to impinge on the transfer roller,

a pair of end seal assemblies secured to said doctor blade head and disposed at opposite ends of said cavity, each end seal assembly including means for establishing a liquid seal with a rotating peripheral surface portion of the transfer roller at a respective end of the transfer roller,

means for supporting said doctor blade head and removably positioning said doctor blade head so that said doctor blades may be moved into and out of engagement with the transfer roller,

said end seal assemblies each including an end plate removably secured to a longitudinally opposed end of said doctor blade head and having a proximal end portion dimensioned to extend across one end of said channel-like cavity in sealing fashion, said end plate further including a distal end portion disposed to impinge on the end surface of the transfer roller,

each of said distal portions of said end plates including a planar surface portion adapted to impinge on the end of said transfer roll, and further including a second surface opposed to said planar surface portion, and groove means extending in said second surface to provide enhanced resilient engagement of said distal end portion against the end surface of said transfer roller.

15. A doctor blade assembly adapted for applying a liquid uniformly to a rotating transfer roller, comprising;

a longitudinally extending doctor blade head having a channel-like cavity formed therein and oriented parallel to the transfer roller, a pair of doctor blades disposed on opposed sides of said cavity and extending the length thereof and adapted to impinge on the transfer roller,

said pair of doctor blades extending parallel to the transfer roller and converging as they extend from

said opposed sides of said cavity toward the transfer roller,

a pair of end seal assemblies secured to said doctor blade head and disposed at opposite ends of said cavity, each end seal assembly including means for establishing a high pressure liquid seal with a rotating peripheral surface portion of the transfer roller at a respective end of the transfer roller and means for overlapping the respective end surface of the transfer roller, and

means for supporting said doctor blade head and removably positioning said doctor blade head so that said doctor blades may be moved into and out of engagement with the transfer roller.

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United States Patent [19]

Bird

[11] **Patent Number:** **4,841,903**

[45] **Date of Patent:** **Jun. 27, 1989**

[54] **COATING AND PRINTING APPARATUS INCLUDING AN INTERSTATION DRYER**

[75] Inventor: **John W. Bird**, Westport, Conn.

[73] Assignee: **Birow, Inc.**, Westport, Conn.

[21] Appl. No.: **65,914**

[22] Filed: **Jun. 24, 1987**

[51] **Int. Cl.**[4] **B05C 11/00**

[52] **U.S. Cl.** **118/46**; 101/201; 101/217; 118/66; 118/258; 118/262; 118/264; 118/602; 427/258; 427/382; 427/411

[58] **Field of Search** 118/46, 66, 602, 258, 118/264, 262; 101/201; 217; 427/382, 258, 411

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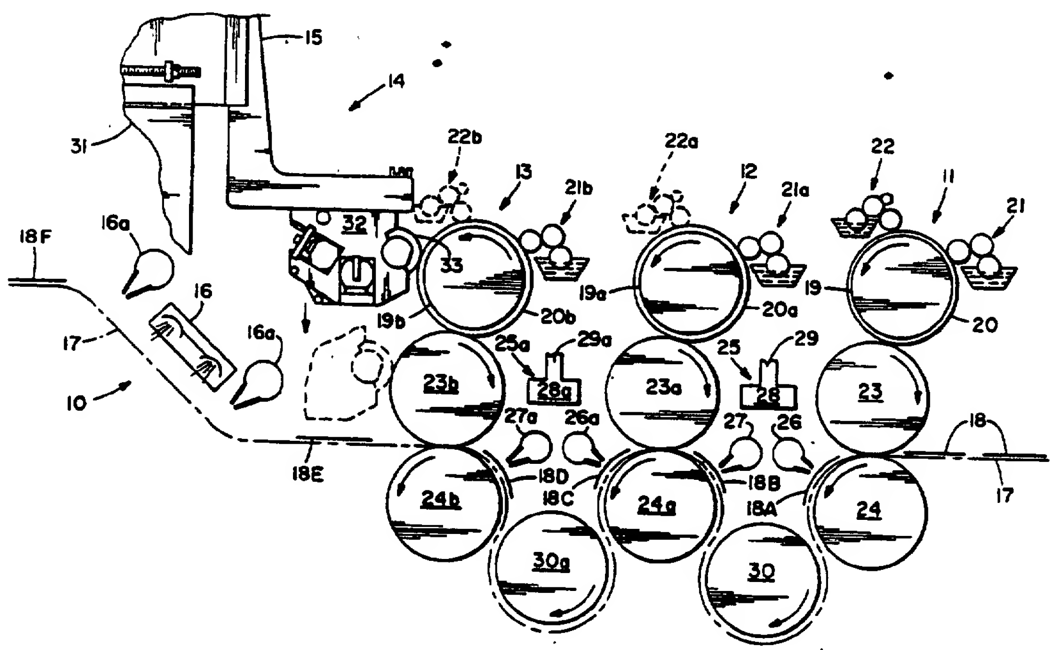
Primary Examiner—Bernard Pianalto

Attorney, Agent, or Firm—Perman & Green

[57] **ABSTRACT**

An offset lithographic printing method and machine having a plurality of in-line liquid application stations, at least one of which is an ink image-printing station for printing lithographic ink images on a suitable receptive copy sheet, and at least the final downstream liquid-application station is a coating application station for printing a protective, and/or aesthetic coating over selected portions of, or over the entire ink image-printed surface of the copy sheet. The present method and apparatus involves the placement of a drying station between liquid application stations to evaporate volatile solvent or vehicle from the ink images and/or to solidify the liquid coating applied at upstream stations before the application of a continuous or spot coating thereover at the next downstream coating station.

5 Claims, 1 Drawing Sheet



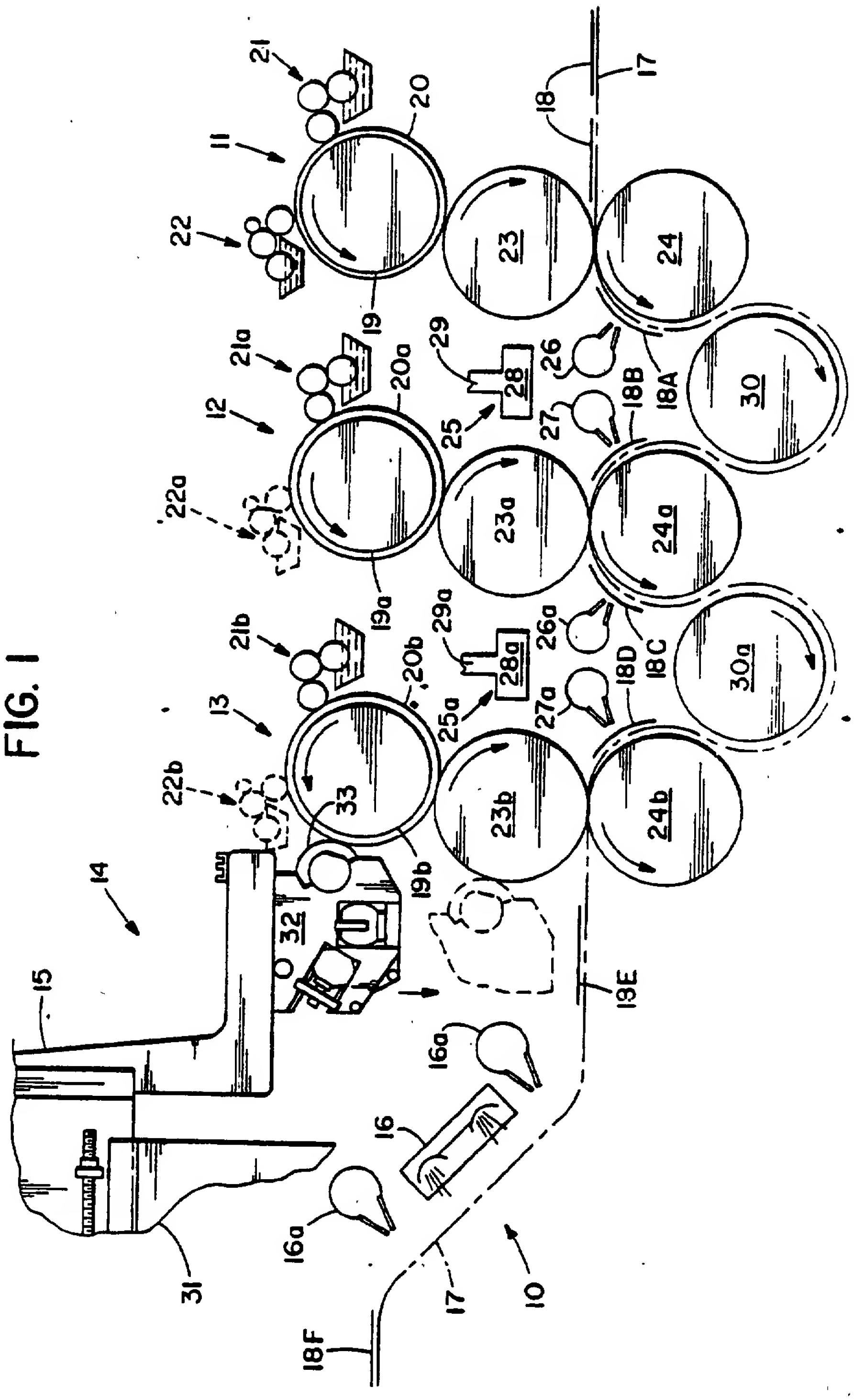

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FIG. 1

COATING AND PRINTING APPARATUS INCLUDING AN INTERSTATION DRYER

BACKGROUND OF THE INVENTION

Conventional lithographic offset printing machines or presses comprise one or more image-printing stations each having a plate cylinder to which is fastened a thin hydrophilic, oleophobic printing plate having image areas which are oleophilic and hydroprobic and background areas which are oleophobic and hydrophilic. The plate surface is continuously wetted with aqueous damping solution, which adheres only to the background areas, and is then inked with oleoresinous ink composition which adheres only to the image areas of the plate as wet ink. The ink is offset-transferred to the rubber surface of a contacting blanket cylinder, and then retransferred to the receptive surface of a copy web or a succession of copy sheets, such as of paper, where the ink gradually hardens or cures by oxidation after passing through a final drying station located downstream of the final liquid application station where the volatile solvent is evaporated from the ink composition of the images.

Since image-curing is gradual, it is conventional to spray the printed copies with starch or other "stilting" powder before the copies are stacked. This prevents sticking of the uncured ink images to adjacent copies and also permits the circulation of air for the oxidation-curing process.

In cases where cost is not a factor and/or where the aesthetic advantages of a protective supercoating are desired, it is known to provide the printing machine with a downstream coating station having a blanket cylinder associated with a coating application unit for the application of an overall protective coating over the entire printed area of the copy sheets or web.

This also avoids the necessity of powdering the printed images. Reference is made to U.S. Pat. No. 4,270,483 for its disclosure of such an apparatus. The coating unit of U.S. Pat. No. 4,270,483 is pivotally-associated with the blanket cylinder for movement between coating and non-coating or retracted positions. Reference is also made to my copending U.S. patent application, Serial No. 65,954, filed on even date herewith.

Protective coating compositions also improve the appearance of printed documents, particularly high quality, multi-color copies such as posters, product brochures, etc., by providing glossy or matte finishes over the entire image-printed surface or over selected image-printed portions thereof such as photographs, product illustrations, etc. Selected area coating, spot coating or perfect registration over predetermined limited printed areas of the copies is advantageous from a cost standpoint since the coating compositions are relatively expensive and the volume required is reduced if the coating is only printed in registration where desired. Also, spot coating is frequently used as a means for highlighting certain portions of the printed copies such as company name or logo, product illustrations, photographs, etc.

While the in-line application of a protective or aesthetic coating over the offset-printed images on a succession of copy sheets will prevent the dried but uncured printed images from sticking to adjacent copy sheets, the relatively wet condition of the printing ink composition and its solvent and/or diluent content, at the time that the coating composition is applied thereover, and the presence of water from the dampening system in the copy sheets, produces a visible change in the appearance of the portions of the coating overlying the printed images during the evaporation of the solvent, diluent, water, etc., whereby, for example, a glossy-surfaced protective coating acquires a flat, matte or non-glossy surface, particularly in areas overlying the dried and cured printed images, and even the affected areas are not uniform in appearance depending upon the colors and/or surface areas of the underlying printed images. For example, printed colored photographs, half-tone illustrations, and the like, which are intended to be emphasized or heightened in appearance, such as by the application of glossy spot coatings thereover, undergo loss or degradation in the uniformity of their appearance and their color during the drying of the copy sheets.

Also, in cases where the protective or aesthetic coating is only spot-applied, such as over printed photographs, product illustrations, etc., the images printed on other surface areas of the copy sheets remain exposed and can stick to adjacent copy sheets unless stilting powder is applied, as discussed herein before.

The speed of operation of conventional offset printing and coating machines makes it impossible to apply successive continuous and spot coatings to a succession of copy sheets because the second coating will not adhere properly to the first coating while the latter is still wet, and/or the second coating will undergo degradation or loss of gloss during drying of the underlying coating.

These defects are of substantial importance in cases where the additional expense of one or more coatings is justified by the desired results, i.e., promotional posters, artwork, product containers, record jackets, videocassette boxes, etc. The defects, i.e., uneven surface appearance of the coating(s), detract from the appearance of the underlying images or photographs, particularly in the case of multi-colored images or photographs and are due to the presence of residual volatile solvents, diluents, water, etc., within the oleoresinous inks of the images or photographs, and the presence of water in the copy sheets, at the time that the first coating is applied thereover, and/or to the presence of volatile solvents, diluents or water within the first coating or undercoating at the time that the second coating is applied thereover. The application of a top coating over the printed images and/or over a first coating retards the volatile solvent, diluent or water against escape in the final drying station, but it eventually migrates into the top coating during the final drying and gradual curing of the ink images over a period of several hours time, resulting in a loss of perfection in the surface finish of the top coating.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a novel printing and coating method and apparatus for the in-line application of one or more protective or aesthetic coatings over imaged subject matter offset-printed onto each of a succession of copy sheets while avoiding the usual degradation or loss of uniformity of the surface appearance of areas of the coating(s) applied over the printed images and/or over underlying coated areas.

It is another objective of the present invention to enable the in-line application of a second protective or aesthetic coating, such as a glossy-finish spot coating, over a first protective coating, such as a continuous matte-finish coating, while avoiding the problems of poor adhesion and degradation or loss of glossy surface appearance of the second coating.

Essentially, the present invention is concerned with providing unblemished coated lithographic copies of the types desired in cases where the additional expense of supercoatings is justified by the desired results.

The present method and apparatus provides for the in-line drying of lithographic ink images, including photographic multi-color reproductions, and/or the drying of first continuous or spot coatings, printed or applied at one liquid application station before the application of a continuous or spot coating over said ink images or over said continuous spot coating at the next downstream liquid application station by interposing an in-line drying station between said one and next liquid application stations in order to more completely dry the ink images or first coating prior to the application of a final coating thereover, whereby the eventual drying of said final coating results in a substantially perfect surface finish

The oleoresinous inks conventionally used to print lithographic copies generally comprise a mixture of oxidizable drying oils, such as safflower oil or linseed oil, a compatible resin binder material, such as a phenolic resin or a varnish, pigment such as carbon black, drying agents, and a volatile solvent such as mineral spirits, or other solvent for the resin and oil. The printed copy sheets also contain some water from the dampening system. Drying of the images occurs in two stages, namely evaporation of the volatile solvent in the first stage to form the relatively dry, tacky printed images, and oxidation-curing of the oleoresinous printed composition which requires several hours time and results in the final non-sticky, smear-resistant printed images. The present invention is concerned with first-stage drying or solvent/water evaporation prior to the application of a supercoating over the printed images

The coating compositions conventionally-used to apply protective or aesthetic coatings over printed lithographic images are aqueous solutions, dispersions or emulsions of water-dispersible or water-soluble film-forming binder materials, such as acrylic resins, hydrophilic colloids, vinyl alcohol, etc. Also, coating compositions free of volatile solvents or vehicles are commonly used, such as resin precursor compositions which are polymerizable or curable by exposure to ultraviolet or other radiation. Such compositions are based upon liquid acrylic monomers or pre-polymers, or photopolymers and photoinitiators, cross-linking agents and/or other conventional ingredients. Both solvent-applied and solvent-free coating compositions can produce microporous coatings which are permeable to oxygen to hasten the curing of the oleoresinous inks. While they are also permeable to the volatile ink solvents, diluents and water, the escape of these volatiles mars the appearance of the surface finish of the coatings, as discussed supra.

The second problem, pertinent to the embodiment of drying between coating stations, relates to the reduced receptivity of wet undercoatings for supercoatings applied thereover, producing uneven, discontinuous or spotty supercoatings having "holidays" or areas which have not accepted the supercoating.

The novel method and apparatus of the present invention overcomes these problems by drying the ink-imaged and/or undercoated copy sheets prior to the application of the undercoating over the ink-printed images and/or prior to the application of the supercoating over the undercoating, whereby substantially-perfect coatings having excellent surface properties, such as gloss, are produced.

DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical cross-sectional view, through the final three liquid application stations of an offset printing machine, illustrating the interposition of in-line drying stations between the last two liquid application stations and a final downstream liquid application station which is a coating-application station.

DETAILED DESCRIPTION OF THE DRAWING

Referring to the drawing, FIG. 1 illustrates a downstream portion of an offset printing machine **10** comprising three liquid application stations **11**, **12** and **13**, a coating apparatus **14** according to aforementioned co-pending application Serial No. 65,954 filed June 24, 1987, comprising a coating carriage **15**, a final radiation drying station **16** including air knives **16a**, and a continuous copy sheet conveyor means **17** which moves a succession of copy sheets **18** through the printing machine.

The first liquid application station **11** is a conventional offset image printing station comprising a plate cylinder **19**, to which is clamped an imaged lithographic printing plate **20** carrying oleophilic image areas, such as words, photographs, etc. on an oleophobic, hydrophilic background. The conventional clamping means permits some degree of lateral or axial adjustment and some degree of wrap-around or circumferential adjustment of the plate **20** relative to the plate cylinder **19**. Plate cylinder **19** is associated with a dampening system **21** for wetting the entire hydrophilic background surface of plate **20** with aqueous dampening fluid, and with an inking system **22** for selectively inking the image areas of the plate **20** with liquid oleoresinous ink composition containing a volatile organic solvent

The inked plate **20** is rotated against the ink-receptive surface of a blanket cylinder **23**, to which the wet ink images are offset or transferred, and the blanket cylinder **23** is rotated against a copy sheet **18**, passed in the nip between the blanket cylinder **23** and an impression cylinder **24**, to transfer the wet ink images to the copy sheet **18** and form an image-printed copy sheet **18A**. Some water from the dampening system is also transferred to the surface of the copy sheet **18A**. Sheet **18A** is conveyed, imaged face up, through a **25** first drying interstation **25**, comprising a pair of spaced, elongate air knives **26** and **27** and a vapor-extraction unit **28** containing an intake fan and a outlet conduit **29** which conveys the volatile vehicle vapors to a recovery unit, to the atmosphere or for **30** other safe disposal.

As illustrated, the printed copy sheets **18A**, are conveyed by grippers past the first air knife **26**, under transfer cylinder **30** and past the second air knife **27**, to form dried printed copy sheets **18B** which move into the next liquid application station **12**.

The air knives **26** and **27** and the extraction unit **28** are conventional elements normally used as final drying elements on printing and coating machines of different types. Knives **26** and **27** are elongate tubular elements provided with an elongate narrow slot formed by op-

posed, converging walls. Heated air is circulated through the tubular elements under pressure and is expelled from the elongate slot as a concentrated narrow band of high speed hot air which is directed against the ink-printed copy sheets 18A to evaporate the volatile solvent and water therefrom to release solvent and water vapor which is withdrawn by the extraction unit 28. Substantial drying is produced by the first air knife 26, and the second air knife 27 preferrably is included, as illustrated, to insure complete drying prior to the entry of the copy sheets 18B to the next liquid application station.

In the apparatus of FIG. 1, the second liquid application station 12 can be either another ink printing station, such as for printing ink of a second color, or it can be a first coating station Thus the various elements of station 12 are numbered similarly to those of station 11 but including the suffix a.

Where station 12 is another ink printing station, the first drying interstation 25, upstream therefrom, functions only as a supplemental drying station and can be excluded or disconnected.

Where station 12 is a first coating application station, the first drying interstation 25 is a critical component of the present invention. In such case, the inking system 22a of station 12 is withdrawn, as shown by means of broken lines, and the dampening system 21a is converted to a dampener coater system by providing a continuous supply of the desired coating composition to the supply pan thereof, i.e., an aqueous dispersion of a film-forming binder material containing in the case of matte-finish coatings, a diffusion filler such as silica or the like.

Generally, where the station 12 is a first coating station, the top roll 19a will be a plate cylinder having a full plate 20a for the application of continuous coatings to the intermediate blanket cylinder 23a or transfer cylinder and then to the dried ink-printed copy sheets 18B to form continuous coated printed copy sheets 18c. However, if desired, plate cylinder 19a may have a spot-receptive plate or relief plate 20a for the transfer of spot coatings to the intermediate blanket cylinder 23a and then to predetermined areas of the printed copy sheets 18B to form spot-coated printed copy sheets 18C.

Most commonly, the first coating will be a complete or continuous coating of a composition providing a matte non-glossy finish or a utility (semi-gloss) finish, and the second coating will be a spot coating of a composition providing a glossy finish to highlight predetermined areas of the printed, coated copies.

The coated printed copy sheets 18C exiting the first coating station 12 are conveyed by grippers, coated side up, through the second drying interstation 25awhich is similar to the first drying station 25 and comprises a similar pair of spaced elongate air knives 26a and 27a and a similar extraction unit 28a and exhaust outlet conduit 29a.

The line of forced hot air from the first knife 26a, across the width of the copy sheets, substantially dries the first coating by evaporating the water vehicle therefrom, after which the dried, coated copy sheets 19D are conveyed by transfer roll 30a to the second air knife 27a to insure complete drying of the first coating prior to the entry of the coated printed copy sheets 18D into the final coating station 13 which includes the coating-application apparatus of the copending application, in the illustrated embodiment, but which may be a conventional coating station.

In cases where the first and/or second coating composition is free of volatiles and solidifies by polymerization curing, the drying interstation 25a and/or downstream drying station 16 will contain a suitable radiation source such as ultraviolet lamps.

The coating application station 13 also can be similar to the inking station 11 and first coating station 12 with respect to the plate cylinder 19b supporting a printing plate dampening system 21b, inking system 22b, blanket cylinder 23b and impression cylinder 24b since, in a conventional offset printing machine having a plurality of liquid application stations, all of the stations are generally similar but use different printing plates to image different areas of the same copy sheet with different colored inks. The present apparatus, requiring at least one coating-application station, and modifies at least the final downstream inking station to convert it permanently or intermittently to a coating-application station as shown by FIG. 1 or, alternatively, as illustrated by U.S. Pat. No. 4,270,483 discussed hereinbefore.

Plate 20b is an offset relief printing plate, preselected areas of which are raised above the background, generally referred to as "relief spots" Such spots are sized and positioned to correspond to areas of the image-printed copy sheets 18D which it is desired to selectively coat.

The adjustable coating apparatus 14 is mounted onto the frame 31 of the printing machine for extension of the coating carriage 15 into the liquid application station 13 for adjustable coating association with either the coating plate cylinder 19b or the coating blanket cylinder 23b, as desired.

The preferred coating application apparatus 14 includes a coating carriage 15 which is horizontally adjustably, in the machine direction, for movement between retracted or passive position and extended or active position, and also vertically adjustable for movement between the levels of the plate cylinder and the blanket cylinder as shown by means of broken lines. Moreover, the coating carriage 15 comprises a horizontally-adjustable coating applicator unit 32 which is movable in the machine direction between different extended coating positions to move the coating applicator roll 33 into coating association with printing and blanket cylinders which are not in vertical alignment, as disclosed in detail in my aforementioned copending application.

Thus, the coating carriage 15 and the applicator unit 32 are adjusted in the final coating station 13 to associate applicator roll 33 with either the spot relief plate 20b on printing roll 19b, for the printing of spot coatings, or with the blanket roll 23b, for the application of continuous coatings onto the dried, coated, printed copy sheets 18D, to form double-coated printed copies 18E. Copies 18E are transported by grippers past a final downstream radiant dryer 16 and air knives 16a, to evaporate the water vehicle from the second coating and form final copies 18F which are stacked to permit final curing of the oleoresinous printing ink.

The essential novelty of the present invention resides in the interposition of a drying station, such as 25 and 25a, between an ink printing station and a coating station, and preferably also between coating stations on machines having a plurality of coating stations, in order to substantially completely evaporate the volatile solvent or vehicle from the printed ink images, and evaporate any residual dampening water from the printed copy sheets, before the application of a spot or continuous coating thereover, and preferably to substantially

completely solidify and dry the first coating such as by irradiating to polymerize or by evaporating the volatile solvent, vehicle and/or water from the coated, printed copy sheets before the in-line application of a second spot or continuous coating over the first-applied coating, as illustrated.

In operation, a succession of copy sheets 18 is automatically gripped by the conveyor means 17 and transported through one or more ink printing stations 11 into printing contact with one or more ink blanket rolls 23 to print images, such as of different colors, on predetermined areas of each copy sheet, using conventional oleoresinous inks containing volatile organic solvent(s). At each ink-printing station 11, an offset printing plate 20 is fastened to a plate cylinder 19, moistened with water/chemical dampening fluid by means of dampening unit 21 and inked by means of inking unit 22. The ink is selectively received by the image areas of the plate 20, where some water dampening solution is picked up by the ink, transferred to the surface of the blanket cylinder 23 and re-transferred to the upper surface of a copy sheet 18 passed in the nip of cylinder 23 and impression cylinder 24. At this point, the ink images on each imaged copy sheet 18A still contain the volatile organic solvent and some water dampening solution which migrates into the copy paper.

Rather than moving the inked copy sheets 18A directly from a printing station 11 to a coating station 12, as is conventional in the art, the present method and apparatus provides for intermediate or interstation drying of the inked copies to evaporate the volatile organic solvent and water dampening solution from the ink images and copy paper to form solvent-free copies 18B prior to the application of a protective and/or aesthetic coating thereover.

In the embodiment of FIG. 1 the ink-printed copies 18A are moved through an interstation drying station 25 by directing the path of the copy sheets down under a transfer cylinder 30 and up over the coating impression cylinder 24a of the coating station 12. The drying of the copy sheets is accomplished by one or more high velocity hot air knife drying elements, such as 26 and 27 shown in FIG. 1, which heat the ink image, sufficiently lowering the solvent vapor pressure while the high velocity air scrubs the vapor from the surface to evaporate substantially all of the volatile organic solvent and water and form substantially solvent-free copies 18B before the copies 18B pass in the coating nip at coating station 12.

The evaporated solvent and moisture is drawn into the solvent extraction unit 28 by an exhaust fan 31 and removed from the ambient atmosphere by conduit 29 for safety purposes.

On machines having a single coating application station, such as station 12 or station 13 of FIG. 1, the solvent-free copies 18B are moved through said coating station 12 or 13 to receive either a continuous or a spot coating to form coated, printed copy sheets 18C which are transported to the final downstream drying station 16, 16a. On machines having two coating stations 12 and 13 used for the application to two superposed coatings, either of which may be spot or continuous, matte or glossy, the dried, printed copy sheets 18B are moved through the first coating station 12 to form coated, printed copy sheets 18C which are moved through the second interstation drying station 25a to form dried coated copy sheets 18D. Sheets 18D are moved through the second coating station 13 and on through the downstream drying station 16, 16a.

After curing for several hours, the coated, printed copies 18F are found to be free of the surface defects of copy sheets printed and coated in similar manner but in the absence of interstation drying.

While the present specification and drawing refer to a continuous copy sheet conveyor means 17 carrying automatic grippers, it will be clear to those skilled in the art that most printing and coating machines convey the copy sheets by means of automatic grippers present on each of a series of contacting cylinders, such as the impression cylinders 24, 24a and 24b and the interposed transfer cylinders 30 and 30a of FIG. 1.

It is to be understood that the above described embodiments of the invention are illustrative only and that modifications throughout may occur to those skilled in the art. Accordingly, this invention is not to be regarded as limited to the embodiments disclosed herein, but is to be limited as defined by the appended claims.

What is claimed is:

1. In a continuous in-line offset lithographic printing machine for printing and coating a continuous succession of receptive copy paper sheets, comprising a plurality of liquid application stations, each comprising a plate cylinder for supporting a lithographic printing plate and including means for supplying oleous printing composition to oleophilic image areas on the water-coated surface of a said printing plate supported thereon, a blanket cylinder for receiving said printing composition and water from said plate cylinder and for transferring said printing composition and water to a succession of individual receptive copy paper sheets, and an impression cylinder forming a nip with said blanket cylinder through which said individual receptive copy paper sheets are passed to receive printing composition and water from said blanket cylinder, at least one said liquid application station being an upstream ink printing station for the transfer of printing composition in the form of ink images containing a volatile vehicle onto said succession of copy sheets, and at least one said liquid application station being a downstream coating station for the application of a printing composition in the form of a continuous or spot coating of liquid composition over the ink-imaged surface of said copy sheets, means for feeding said succession of individual receptive copy paper sheets through the nips of said blanket and impression cylinders of said liquid application stations, and a final downstream drying station for drying or otherwise solidifying said coated copy paper sheets, the improvements which comprises an intermediate in-line drying station positioned after each of said liquid application stations, each said drying station comprising means for directing forced hot air against the ink printed copy paper sheets to effect the evaporation of water and the volatile vehicle from the ink images printed on said copy paper sheets prior to the entry of the ink-imaged copy paper sheets into the next liquid application station including into said coating station.

2. A printing machine according to claim 1 having two adjacent downstream coating stations, characterized by the presence of another intermediate in-line drying station positioned in-line therebetween to effect the solidification of the coating applied at the first coating station prior to the entry of the coated copy sheets into the second coating station.

3. A printing machine according to claim 1 in which said coating station comprises a coating application assembly which is adjustably supported for coating association with either the plate cylinder, for the application of spot coatings, or the blanket cylinder, for the application of continuous coatings, to said copy sheets.

4. A printing machine according to claim 1 in which said intermediate drying station also comprises a vapor extraction means.

5. A printing machine according to claim 1 in which said means comprises an air knife.

* * * * *

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United States Patent [19]

Komori

[11] **Patent Number:** 4,848,265

[45] **Date of Patent:** Jul. 18, 1989

[54] **PRINTING APPARATUS HAVING COATING FUNCTION**

[75] Inventor: **Tatsuo Komori**, Toride, Japan

[73] Assignee: **Komori Printing Machinery Co., Ltd.**, Tokyo, Japan

[21] Appl. No.: **130,011**

[22] Filed: **Dec. 8, 1987**

[30] **Foreign Application Priority Data**

Jan. 30, 1987 [JP] Japan 62-018689

[51] **Int. Cl.**[4] **B05C 11/00**

[52] **U.S. Cl.** **118/46**; 101/76; 101/216; 101/349; 101/DIG. 49

[58] **Field of Search** .... 118/46; 101/76, 77, 101/72, 217, 232, 247, 248, 349, DIG. 28, 152, 153, 179, 216, 375, 376, 377, 328, 331, 330, 329

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Primary Examiner—Clifford D. Crowder

Attorney, Agent, or Firm—Rosen, Dainow & Jacobs

[57] **ABSTRACT**

A printing apparatus which is provided with an integral rotary shaft supported on the main unit's frames, a numbering device, a relief imprinting cylinder, and a coating cylinder which are detachably and alternatively mounted on the rotary shaft from its periphery, and an ink unit and a coater unit, thereby enabling coating operations as need in addition to numbering and imprinting operations.

5 Claims, 6 Drawing Sheets

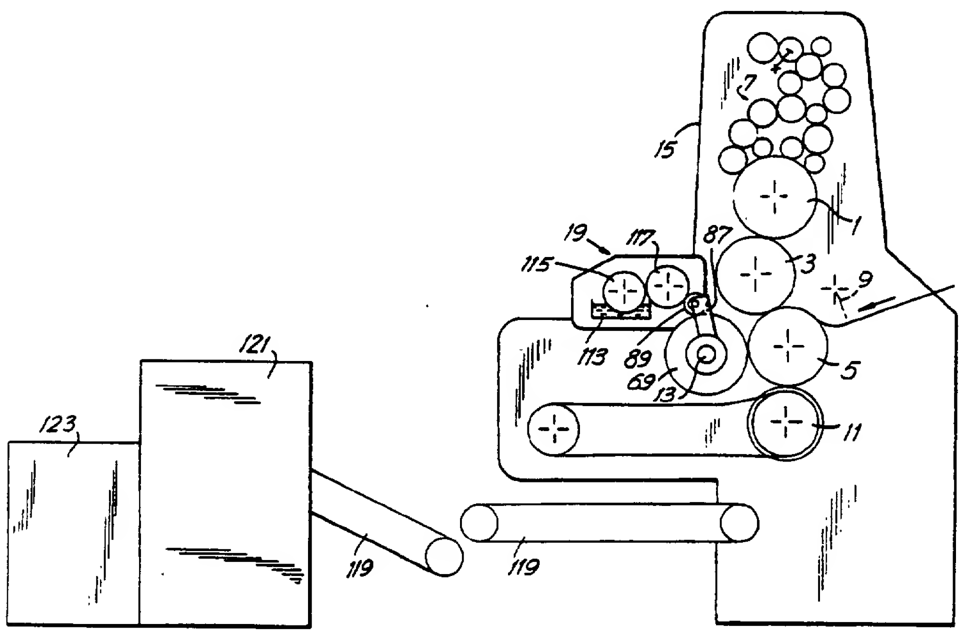
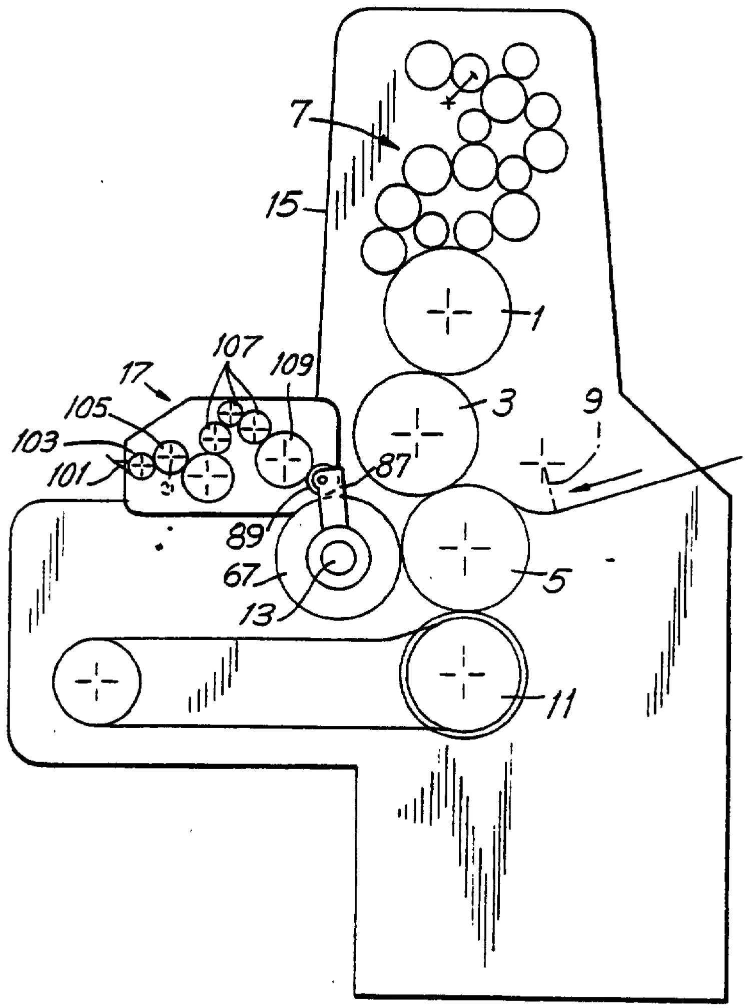


FIG.1



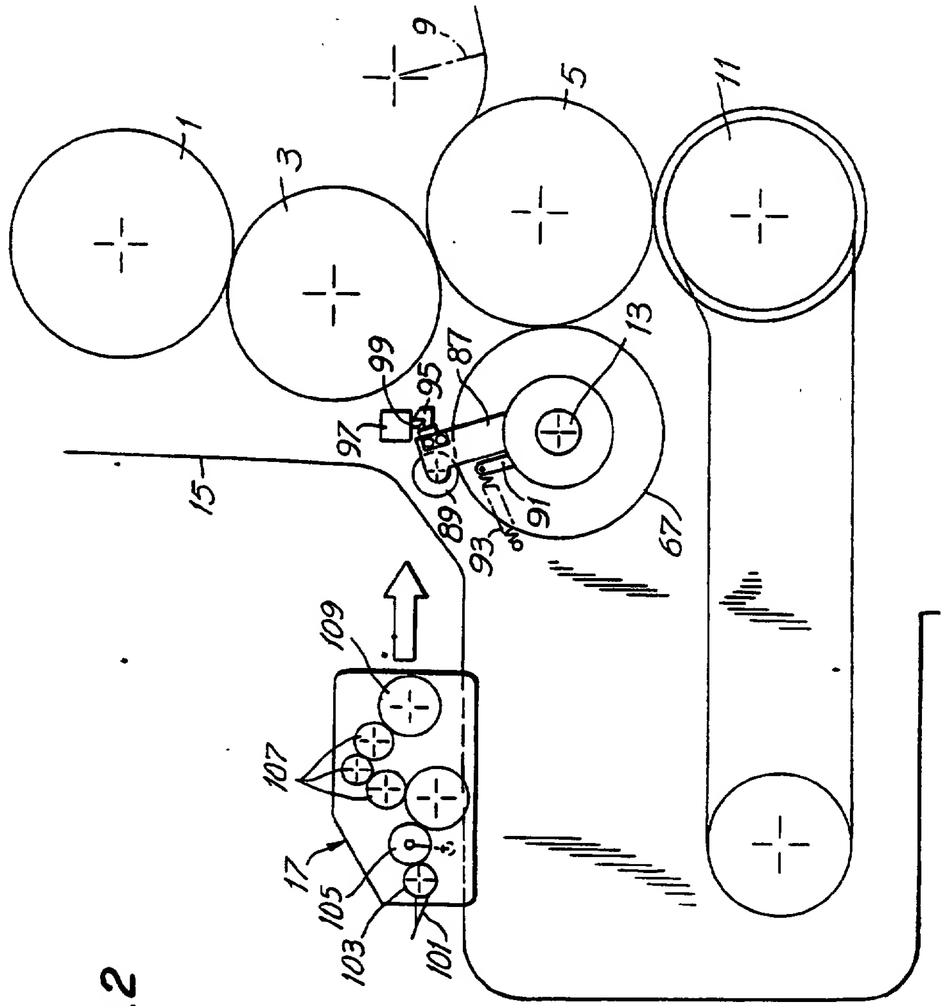


FIG.2

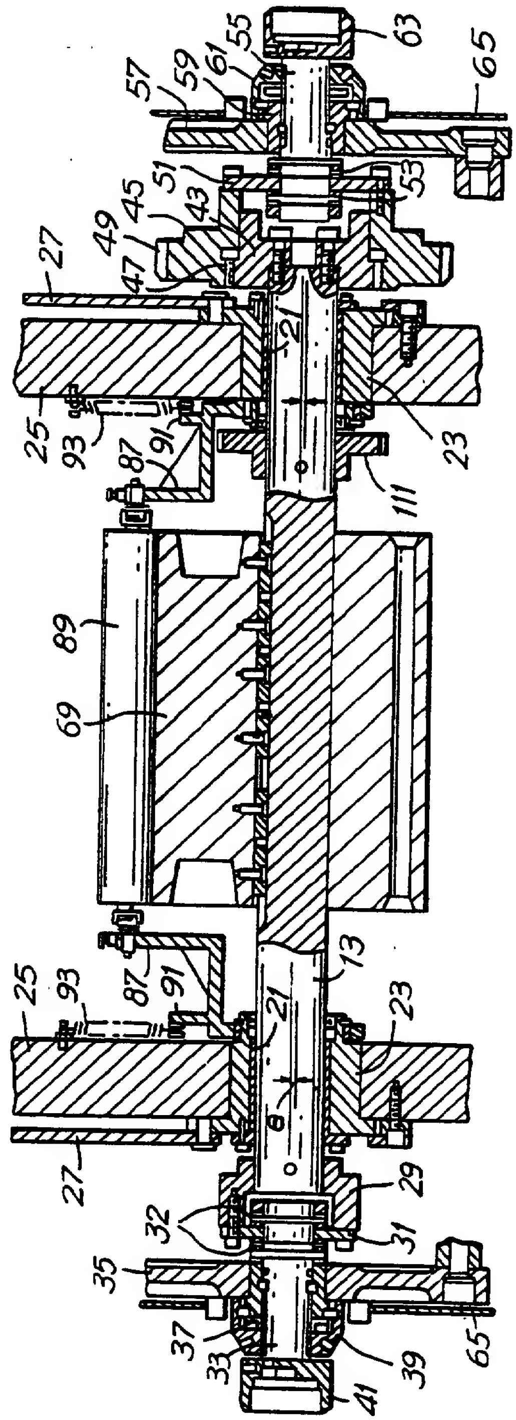


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FIG.3

FIG. 4

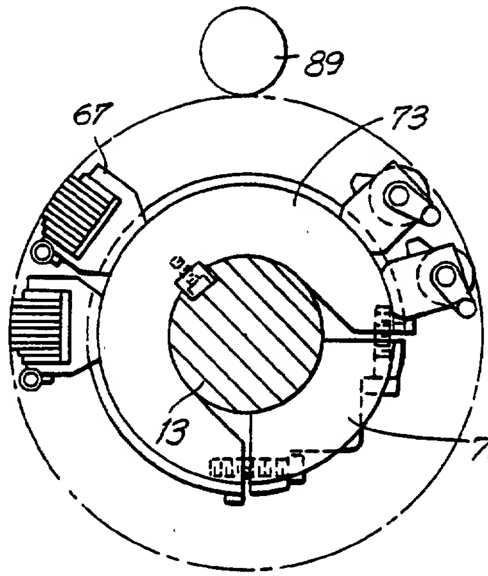


FIG. 5

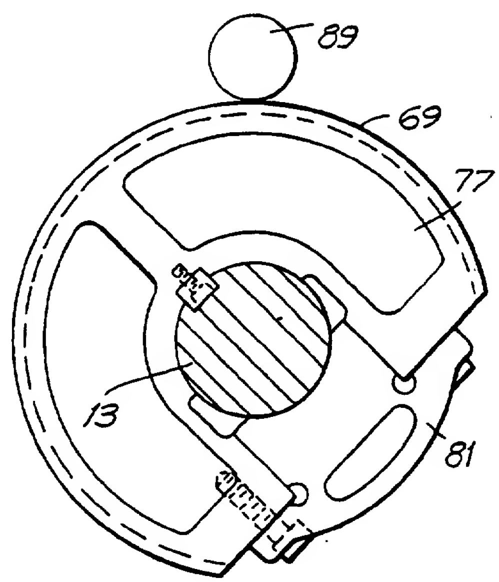
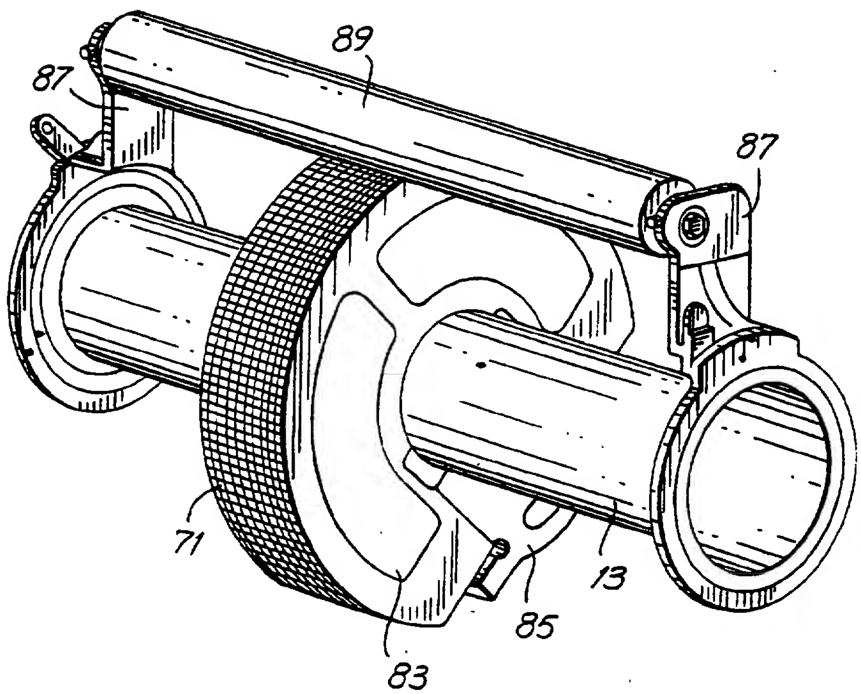


FIG. 6



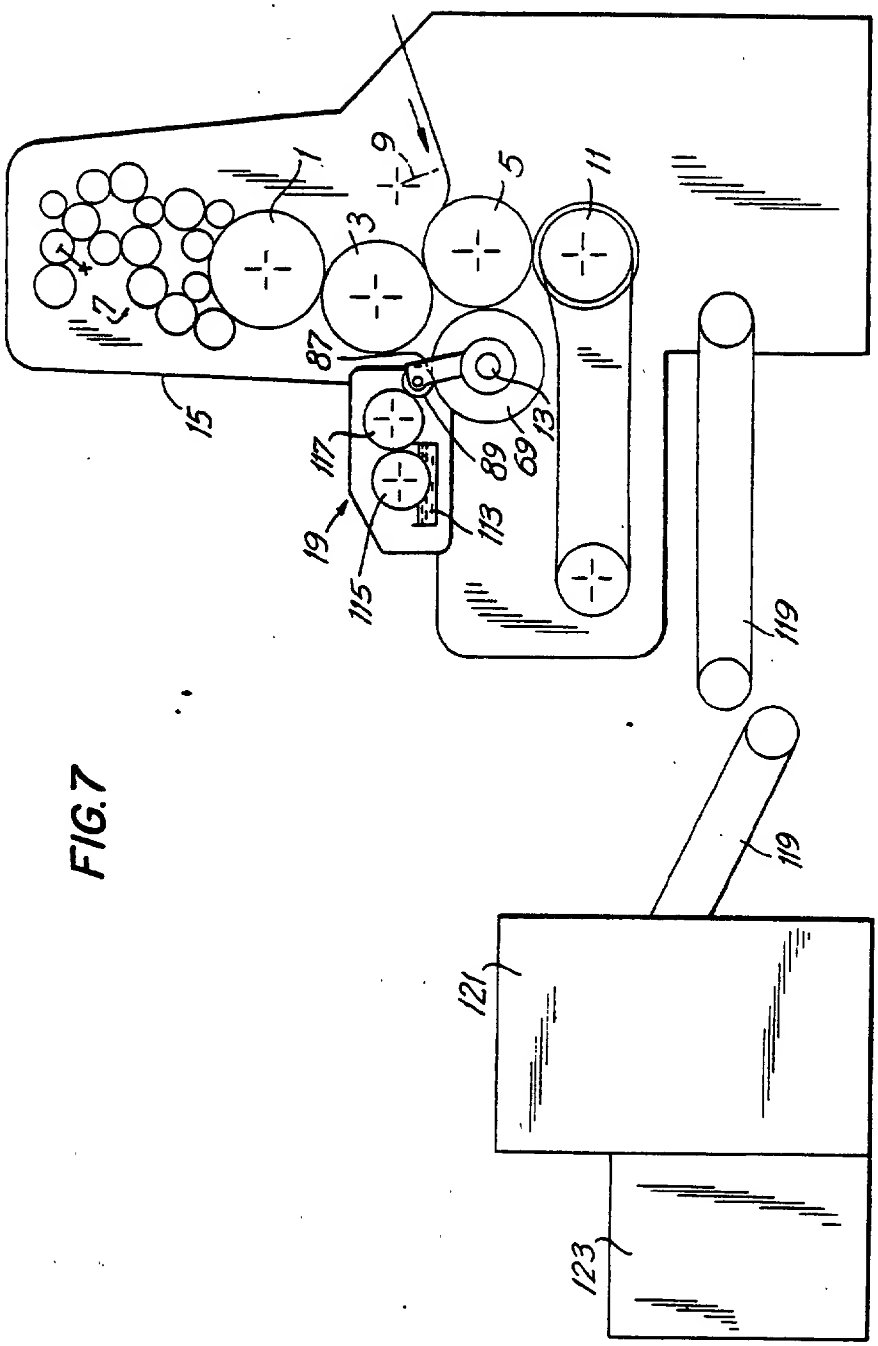


FIG.7

PRINTING APPARATUS HAVING COATING FUNCTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a printing apparatus which enables coating operation as needed in addition to numbering and imprinting.

2. Description of the Prior Art

Printed matters which require a good-looking appearance such as book covers, catalogs, and pamphlets are often coated with a varnish which forms a film on the printed paper to prevent the surface from staining and give it a gloss. The coating operation may be performed by an independent device (coater), but in many cases it is carried out by a coater provided in a delivery passage of a printing apparatus to perform the coating operation immediately following the print operation for improved working efficiency.

On the other hand, in some cases, a numbering and imprinting device is provided in the delivery passage of the printing apparatus for partial imprinting or numbering. In the numbering and imprinting device, a numbering device can be attached to a printing shaft to perform numbering, or a relief imprinting cylinder in place of the numbering device can be attached to the printing shaft to perform imprinting.

In prior art printing presses, the coater or the numbering and imprinting device is provided as an independent device.

As described above, since the coater and the numbering and imprinting device are separate devices in the prior art printing presses, both devices must be installed when a coating operation is required in addition to numbering and imprinting operations, which result in an increase in equipment cost and installation space.

When one designs a printing apparatus that can perform the coating operation in addition to the numbering and imprinting operation, there occur the following problems. The printing shaft of the numbering and imprinting device is normally divided into shaft supporting sections at both ends of the shaft and a central section to support the numbering device or the like, in order to facilitate attaching and detaching of the numbering device or an relief imprinting cylinder to and from the printing shaft and cleaning of an impression cylinder which is located at the rear side of the printing shaft. Thus, only the central section of the printing shaft can be removed from the printing apparatus, and the above numbering device or the relief imprinting cylinder can be attached to the removed central section of the printing shaft, thereby facilitating attaching the device. Further, the removal of the central section of the printing shaft results in a space in the printing apparatus, which facilitates cleaning the inside of the printing apparatus. However, since the central section of the shaft is detachably mounted on the shaft supporting sections with retaining means such as bolts, the central section can possibly be mounted eccentrically relative to the shaft supporting sections with restricted mounting accuracy. For the case of the coater, a coating cylinder to coat a varnish or the like on the print paper in combination with the impression cylinder is required to make exact rotation. If the coating cylinder rotates eccentrically, the distance between the coating cylinder surface and the impression cylinder varies as it turns with a variation in contact pressure, which results in uneven thickness of the coating layer. Since a quick-drying type varnish is used, all of the varnish supplied to the coating cylinder must be transferred to the paper surface. However, if there is an eccentric rotation of the coating cylinder, flow of the varnish is interrupted and the varnish hardens on the coating cylinder, which results in increased unevenness greater than due to the eccentric rotation of the coating cylinder. Therefore, printed matter with enhanced gloss cannot be obtained. As compared with numbering, coating requires an increased printing pressure. However, if the central section of the printing shaft is fastened with a bolt, the central section is liable to shift in the direction perpendicular to the axis of the bolt, which results in an increased eccentricity and vibration. Therefore, it is practically impossible to attach the coating cylinder to the central section of the printing shaft.

Further, since normally the prior art coating cylinder has been integrally combined with the shaft supporting sections, the whole frames supporting the coating cylinder must be dismantled to remove the coating cylinder, which has made it difficult to remove and replace the coating cylinder.

SUMMARY OF THE INVENTION

With a view to obviate all of the prior art defects of printing presses, it is a primary object of the present invention to provide a printing apparatus which can perform coating operation in addition to numbering and imprinting.

In accordance with the present invention which attains the above object, there is provided a printing apparatus having a coating function, comprising in the vicinity of an impression cylinder an integral rotary shaft supported at its both ends on frames of a printing apparatus main unit and driven to rotate in synchronization with the impression cylinder, a numbering device, a relief imprinting cylinder and a coating cylinder, which are selectively and detachably mounted on the peripheral surface of the rotary shaft and operating in combination with the impression cylinder, an ink unit detachably mounted on the printing apparatus main unit for supplying ink to the numbering device or the relief imprinting cylinder, and a coater unit detachably mounted, alternatively to the ink unit, on the printing apparatus main unit for supplying the coating cylinder with a coating material.

For number printing with the printing apparatus according to the present invention having the above-described arrangement, the numbering device is mounted on the rotary shaft and the ink unit is installed on the printing apparatus main unit. The numbering device is supplied with ink from the ink unit to print a number on matter to be printed on which is inserted between the numbering device and the impression cylinder. Imprinting is performed using the relief imprinting cylinder in place of the numbering device, which is attached to the rotary shaft. For coating operation, the coating cylinder is mounted on the rotary shaft and the coater unit is installed on the printing apparatus main unit. The coating cylinder is supplied with the coating material from the coater unit, and the coating material is coated on the matter to be printed which is inserted between the coating cylinder and the impression cylinder.

Other and further objects of this invention will become obvious upon an understanding of the illustrative

embodiment about to be described or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of an embodiment of the sheet-feed offset printing apparatus according to the present invention.

FIG. 2 is a schematic view showing part of the embodiment of the sheet-feed offset printing apparatus shown in FIG. 1.

FIG. 3 is a schematic vertical sectional view of a rotary shaft provided with a coating cylinder.

FIG. 4 and FIG. 5 are side views of a numbering device and the coating cylinder, respectively.

FIG. 6 is a schematic oblique view showing a relief imprinting cylinder mounted on the rotary shaft.

FIG. 7 is a schematic view of the printing apparatus according to the present invention which is set up for coating operation.

DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of the present invention when applied to a printing apparatus will be described with reference to the drawings. Referring to FIG. 1, numeral 1 indicates a plate cylinder, numeral 3 indicates a blanket cylinder, number 5 indicates an impression cylinder, numeral 7 indicates an ink feeder for plate cylinder, number 9 indicates a sheet feeder, and numeral 11 indicates a sheet discharger. A line pattern transferred from the plate cylinder 1 to the blanket cylinder is imprinted on a sheet of paper supplied from the sheet feeder 9 into between the blanket cylinder 3 and the impression cylinder 5, and the printed sheet is discharged by the sheet discharger 11. In a sheet discharge passage between the impression cylinder 5 and the sheet discharger 11, a rotary shaft 13 is disposed adjacent to the impression cylinder 5, which is commonly used for numbering, imprinting, and coating. An ink unit 17 is detachably mounted opposing the rotary shaft 13 on a printing apparatus main unit 15. The mounting location of the ink unit 17 on the printing apparatus main unit 15 can be detachably mounted with a coater unit 19 which will be described later herein, alternatively to the ink unit 17 (FIG. 7).

As shown in FIG. 3, the rotary shaft 13 is an integrally formed cylinder, supported at its both ends by eccentric bushings 23 through bearing metals 21, and the eccentric bushings 23 are supported by main unit frames 25. The eccentric bushings 23 are rotatably supported by the main unit frames 25 and have an eccentricity e between the center of the inner peripheral surfaces of the bushings 23 contacting with the bearing metals 21 and the center of the outer peripheral surfaces contacting with the main unit frames 25, thereby allowing movement of the axial center position of the rotary shaft 13 by changing the phase angle of the eccentric bushings 23 through rods 27 mounted on the eccentric bushings 23. Thus, by turning the eccentric bushings 23, the rotary shaft 13 is moved and the distance between axial centers of the rotary shaft 13 and the impression cylinder 5 is adjusted for adapting for the thickness of paper to be printed and withdrawal of the rotary shaft 13 in the event of a malfunction. The rotary shaft 13 can be removed and inserted in the axial direction with the bearing metals 21 attached to the main unit frames 25.

The central part of the rotary shaft 13 other than its both ends supported by the bearings has a smaller diameter by more than its fitting tolerance than the inner diameter of the bearing metals 21. Therefore, by removing a plate position adjusting device which will be described later, the rotary shaft 13 can be easily removed with the bearing metals 21 left on the main unit frames 25, thereby improving the efficiency of cleaning the impression cylinder 5.

Further, the rotary shaft 13 has the plate position adjusting device for fine adjustment of the axial position of the rotary shaft 13 and its rotational phase relative to the impression cylinder 5. A disk 31 is mounted at one end of the rotary shaft 13 (left end in FIG. 3) through a bracket 29, and an axial adjusting shaft 33 is connected unmovably in the axial direction but rotatably to the rotary shaft 13 through thrust bearings 32 disposed at both sides of the disk 31. The axial adjusting shaft 33 is screwed in a nut 37 of a supporting frame 35 fixed to the main unit frame 25, and is normally fixed to the supporting frame 35 with a lock nut 39. A knob 41 is provided at the end of the axial adjusting shaft 33. With the lock nut 39 loosened, the knob 41 can be turned to rotate the axial adjusting shaft 33 and move it forward and reverse, which is screwed in with the nut 37, thereby transmitting the movement to the rotary shaft 13 through the disk 31 to move the rotary shaft 33 axially. Thus, the axial position of the rotary shaft 13 is adjusted.

A spur gear 43 is mounted at the other end of the rotary shaft 13 (right end in FIG. 3), which engages with an internal spur gear 47 provided in a drive gear member 45. The drive gear member 45 engaged with the spur gear 43 can be moved relatively in the axial direction together with the spur gear 43. A helical gear 49 is provided on the outer periphery of the drive gear member 45, and the helical gear 49 engages with an impression cylinder gear which is not shown. Thus, rotation of the impression cylinder 5 is transmitted to the drive gear member 45 through the helical gear 49 which, through the spur gear 43, further rotates the rotary shaft 13 in synchronization with the impression cylinder 5. The drive gear member 45 is mounted with a disk 51, and connected with a circumferential adjusting shaft 55 through a thrust bearing 53 similarly to the construction of the left end of the rotary shaft 13. The circumferential adjusting shaft 55 is screwed with a nut 59 of a supporting frame 57 mounted on the main unit frame 25 and normally fixed to the supporting frame 57 with a lock nut 61. With the lock nut 61 loosened, a knob 63 which is provided at the end of the circumferential adjusting shaft 55 can be turned to rotate the circumferential adjusting shaft 55 and move it forward and reverse in the axial direction, thereby moving the drive gear member 45 in the axial direction. The axial movement of the drive gear member 45 changes the engaging phase of the helical gear 49 with the impression cylinder gear, thereby adjusting the rotational phase of the rotary shaft 13 relative to the impression cylinder 5. The movement of the rotary shaft 13 by the axial adjusting shaft 33 and the relative axial movement of the spur gear 43 and the drive gear member 45 through the movement of the drive gear member 45 by the circumferential adjusting shaft 55 are absorbed by a relative movement of the spur gear 43 and the drive gear member 45 in the gear tooth direction.

Thus, the printing position or coating position can be adjusted horizontally and vertically by the axial and

circumferential movement of the rotary shaft 13. Numeral 65 in FIG. 3 indicates a cover.

The rotary shaft 13 is detachably mounted alternatively with a numbering device 67 as shown in FIG. 4, a coating cylinder 69 as shown in FIG. 5, or a relief imprinting cylinder 71 as shown in FIG. 6. FIG. 3 shows the rotary shaft 13 mounted with the coating cylinder 69. Each of the numbering device 67, the coating cylinder 69, and the relief imprinting cylinder 71 is cut out of part of its circumference so that it can be mounted and detached from the peripheral surface of the rotary shaft 13, and the cutout can be detachably mounted with a cap. Referring to FIG. 4, the numbering device 67 is mounted on a mount 73 having a cutout which allows the rotary shaft 13 to pass, so that the position of the numbering device 67 can be circumferentially adjusted. The mount 73 can be mounted at any axial position on the rotary shaft 13 so that the rotary shaft 13 is placed between the mount 73 and a cap 75. Referring to FIG. 5, the coating cylinder 69 comprises a mount 77 with a partial cutout and a resin sheet stuck on the outer peripheral surface of the mount 77, and is detachably mounted on the rotary shaft so that the rotary shaft 13 is pinched between the mount 77 and a cap 81 in the case of the numbering device 67. The sheet on the surface of the coating cylinder 69 is provided on a part corresponding to that to be coated. For example, to coat the overall surface of a sheet, the sheet is provided on the overall surface of the coating cylinder 69, or for coating partly, the sheet is provided only on the corresponding part of the surface of the coating cylinder 69. Similarly, as shown in FIG. 6, the relief imprinting cylinder 71 can be detachably mounted on the rotary shaft 13 using a mount 83 and a cap 85. Thus, one of the numbering device 67, the coating cylinder 69, and the relief imprinting cylinder 71 is alternatively mounted on the rotary shaft 13 as needed.

As shown in FIG. 3, on the eccentric bushings 23 at both ends of the rotary shaft 13 bosses of levers 87 are mounted. Rotational centers of the levers 87 are aligned with the centers of inner peripheral arcs of the eccentric bushings 23, that is the rotational center of the rotary shaft 13. An application roller 89 is detachably mounted between the ends of the levers 87 so that the application roller 89 extends in parallel to the rotary shaft 13 and is in rotatable contact with the outer peripheral surface of the numbering device 67, the coating cylinder 69, or the relief imprinting cylinder 71 mounted on the rotary shaft 13. The application roller 89 is replaced at the same time the ink unit 17 and the coater unit 19 are replaced. The application roller 89 for ink is used for numbering or imprinting operation, or the application roller 89 for coating material is used for coating operation.

The bosses of the levers 87 have projecting mounting pieces 91. Springs 93 are stretchedly provided between the mounting pieces 91 and the main unit frames 25, and the stretching force of the springs 93 urges the levers 87 counter-clockwise in FIG. 2. The levers 87 are mounted with swing claws 95, and the swing claws 95 detachably hook on hooking pieces 99 which are projectingly provided on supporting bars 97 mounted on the main unit frames 25, thereby restricting rotation of the levers 87 due to the springs 93.

Referring to FIG. 1 and FIG. 2, the ink unit 17 has an ink bottle 101, a bottle roller 103, a transfer roller 105, an intermediate leveling roller 107, and a leveling roller 109 which contacts with the application roller 89. The ink unit 17 is detachably mounted, using a conventional method known in the art, on an opening of the printing apparatus main unit 15 provided opposing the application roller 89. With the ink unit 17 mounted, the leveling roller 109 contacts with the ink application roller 89, and the rollers 89 and 109 are pressed against each other with an adequate nip pressure provided by the springs 93. The ink unit 17 also has a drive gear mechanism (not shown) for these rollers 101, 103, 107, and 109, and is driven by the drive gear mechanism which engages with a gear 111 (see FIG. 3) mounted on the rotary shaft 13 when the ink unit 17 is installed on the printing apparatus main unit 15.

As shown in FIG. 7 showing schematically the printing apparatus according to the present invention which is ready for coating operation, the coater unit 19 has a varnish boat 113, a pick-up roller 115 which is partly dipped in the varnish boat 113, and a metering roller 117 which contacts with the application roller 89 for coating material mounted on the printing apparatus main unit 15, and is detachably mounted on the printing apparatus main unit 15 as in the case of the ink unit 17. With the coater unit installed on the printing apparatus main unit 15, the metering roller 117 is pressed against the application roller 89 with an adequate pressure by the urging force of the springs 93, and a drive gear mechanism (not shown) in the coater unit 19 engages with the gear 111 as in the case of the ink unit 17.

For performing a numbering operation with the above-described arrangement, the numbering device 67 is mounted on the rotary shaft 13 and the ink unit 17 on the printing apparatus main unit 15, as shown in FIG. 1 and FIG. 2. Ink is supplied from the leveling roller 109 to the numbering device 67 through the ink application roller 89, and number printing is made on paper to be printed which is inserted between the numbering device 67 and the impression cylinder 5. For imprinting, the relief imprinting cylinder 71 is mounted on the rotary shaft 13 in place of the numbering device 67 as shown in FIG. 6, and other operations are the same as for the numbering operation.

For a coating operation, the coating cylinder 69 is mounted on the rotary shaft 13 and the coater unit 19 is mounted on the printing apparatus main unit 15 as shown in FIG. 7. A coating material such as varnish is supplied from the metering roller 117 to the coating cylinder through the application roller 89 for coating material, and coated on paper to be printed which is inserted between the coating cylinder 69 and the impression cylinder 5. A conveyer belt 119 is disposed beneath the sheet discharger 11, and a coated sheet discharged from the sheet discharger 11 is carried by the conveyer belt 119 to a dryer 121 where the sheet is dried and then put into a pile 123. The coating position is adjusted by the plate position adjusting device.

Since, in the above-described embodiment according to the present invention, the numbering device 67, the application roller 89 which contacts directly with the coating cylinder 69, or the relief imprinting cylinder 71 is disposed on the printing apparatus main unit 15, a constant nip pressure between the application roller 89 and the numbering device 67, the coating cylinder 69, or the relief imprinting cylinder 71 is achieved irrespective of movement of the rotary shaft 13, the ink unit 17 or the coater unit 19. Therefore, the nip pressure is unnecessary to be adjusted even when the ink unit 17 or the coater unit 19 is inserted in place of another unit, and an adequate amount of ink or coating material can

always be maintained. In the present invention, the application roller 89 which contacts directly with the numbering device 67, the coating cylinder 69, or the relief imprinting cylinder 71 can be alternatively provided on the side of the ink unit 17 or coater unit 19. In some cases, the plate position adjusting device can be omitted.

As described in detail above, the embodiment of the present invention uses the integral rotary shaft which can be easily supported at a high precision, which enables numbering, imprinting and coating operations by a single printing apparatus, thereby reducing the equipment cost and installation space.

I claim:

1. A printing apparatus having a coating function comprising an integral rotary shaft disposed adjacent to an impression cylinder, supported at both ends within apertures in a main unit frame means and driven to rotate synchronously with said impression cylinder, said main frame means comprising two integral main frame members each of which has an aperture therein and wherein said rotary shaft is supported at its both ends through said apertures, a numbering device, a relief imprinting cylinder, and a coating cylinder alternatively mounted detachably on said rotary shaft, an ink unit detachably mounted on a printing apparatus main unit for supplying ink to said numbering device or said relief imprinting cylinder, and a coater unit detachably mounted alternatively to said ink unit on said printing apparatus main unit for supplying a coating material to said coating cylinder, said outer diameter of said rotary shaft being smaller than the inner diameter of said apertures of said frame means, said frame means including bearing metals and wherein said rotary shaft is supported at its both ends by said bearing metals, the central part of said rotary shaft intermediate its both ends which are supported by said bearing metals has a diameter which is smaller than an inner diameter of at least one of said bearing metals thereby enabling the removal of said rotary shaft in the axial direction without removing said bearing metals from said main unit frame means.

2. A printing apparatus having a coating function as claimed in claim 1, wherein each of said numbering device, said relief imprinting cylinder, and said coating cylinder comprises a continuous ring-shaped mount having a cutout on part of its circumference so as to allow said rotary shaft to pass through, and a cap detachably mounted on said cutout of said mount for supporting said rotary shaft between said cap and said mount.

3. A printing apparatus having a coating function as claimed in claim 2, wherein an application roller for ink rotatably contacting an outer peripheral surface of said numbering device or said relief imprinting cylinder mounted on said rotary shaft is detachably mounted parallel to said rotary shaft in said printing apparatus main unit, and said ink unit has a leveling roller rotatably contacting said outer peripheral surface of said application roller for supplying said application roller with ink.

4. A printing apparatus having a coating function as claimed in claim 2, wherein an application roller for coating material rotatably contacting with the outer peripheral surface of said coating cylinder mounted on said rotary shaft is detachably mounted parallel to said rotary shaft in said printing apparatus main unit, and said coater unit has a metering roller rotatably contacting with the outer peripheral surface of said application roller for coating material for supplying said application roller with coating material.

5. A printing apparatus having a coating function comprising a single rotary shaft means disposed adjacent to an impression cylinder, supported at both ends within apertures in a main unit frame means and driven to rotate synchronously with said impression cylinder, said main frame means comprising two integral main frame members each of which has an aperture therein and wherein said rotary shaft is supported at its both ends through said apertures, a numbering device, a relief imprinting cylinder, and a coating cylinder alternatively mounted detachably on said rotary shaft, an ink unit detachably mounted on a printing apparatus main unit for supplying ink to said numbering device or said relief imprinting cylinder, and a coater unit detachably mounted alternatively to said ink unit on said printing apparatus main unit for supplying a coating material to said coating cylinder, said outer diameter of said single rotary shaft being smaller than the inner diameter of said apertures of said frame means, said frame means including bearing metals and wherein said rotary shaft is supported at its both ends by said bearing metals, the central part of said rotary shaft intermediate its both ends which are supported by said bearing metals has a diameter which is smaller than an inner diameter of at least one of said bearing metals thereby enabling the removal of said rotary shaft in the axial direction without removing said bearing metals from said main unit frame means.

* * * * *

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United States Patent [19]

Terasaka et al.

[11] **Patent Number:** **4,852,515**

[45] **Date of Patent:** **Aug. 1, 1989**

[54] **DEVICE FOR AUTOMATICALLY CONTROLLING COATING AMOUNT FOR USE IN COATING MACHINE**

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[73] Assignee: **Chugai Ro Co, Ltd.**, Japan

[21] Appl. No.: **875,624**

[22] Filed: **Jun. 18, 1986**

Related U.S. Application Data

[63] Continuation of Ser. No. 610,691, May 16, 1984, abandoned.

[30] **Foreign Application Priority Data**

May 25, 1983 [JP] Japan 58-93247

[51] **Int. Cl.⁴** **B05C 11/00**

[52] **U.S. Cl.** **118/663**; 118/262; 72/16; 100/47

[58] **Field of Search** 118/663, 262; 101/247; 100/47, 50; 72/16, 18

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Primary Examiner—Shrive Beck

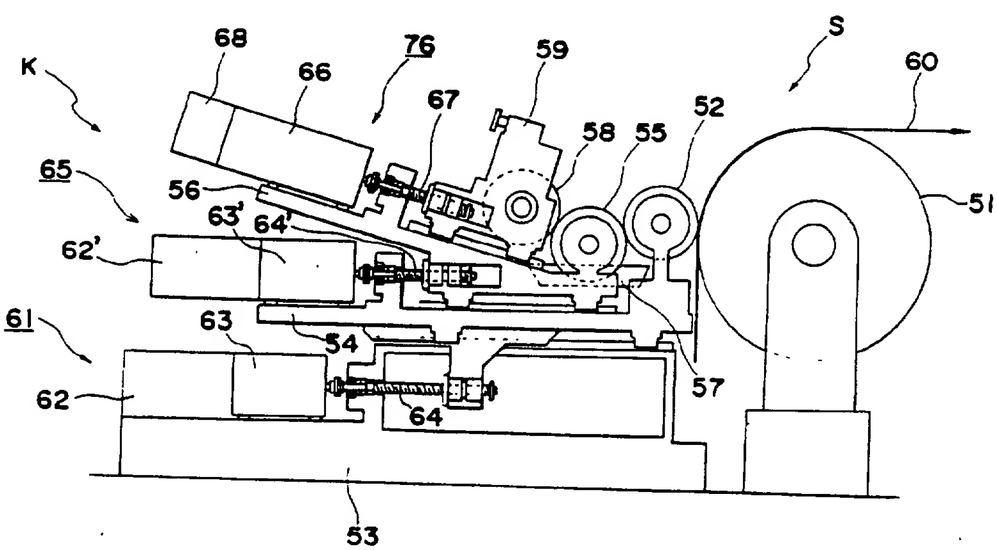
Assistant Examiner—Alain Bashore

Attorney, Agent, or Firm—Jackson & Jones

[57] **ABSTRACT**

A device for automatically controlling coating amount for use in a coating machine including a backup roll, an applicator roll, a pickup roll, a base, a first table slidably mounted on the base and a second table slidably mounted on the first table. The device includes first and second pressure adjusting mechanisms for adjusting a pressure between the backup roll and the applicator roll and a pressure between the applicator roll and the pickup roll. Each of the first and second pressure adjusting mechanisms further includes a sensor, a stepping motor and a precision ball bearing screw member.

13 Claims, 4 Drawing Sheets



W019474

Fig. 1 PRIOR ART

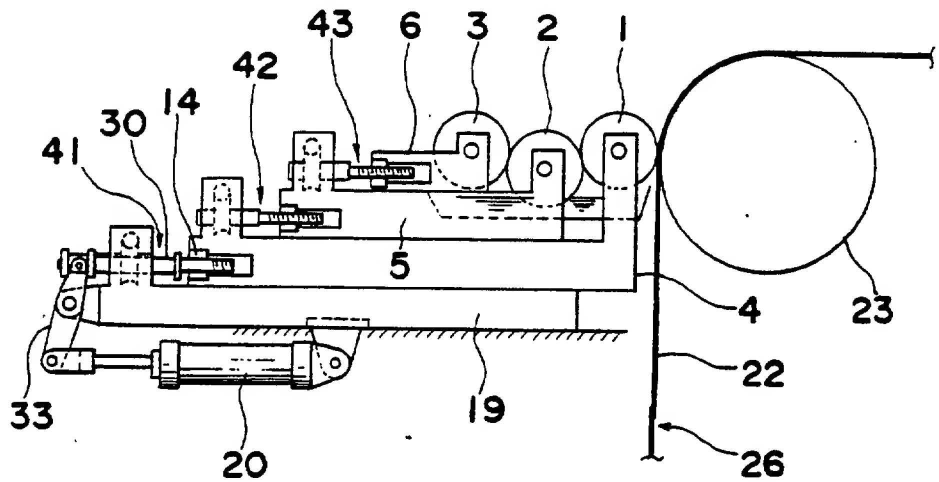
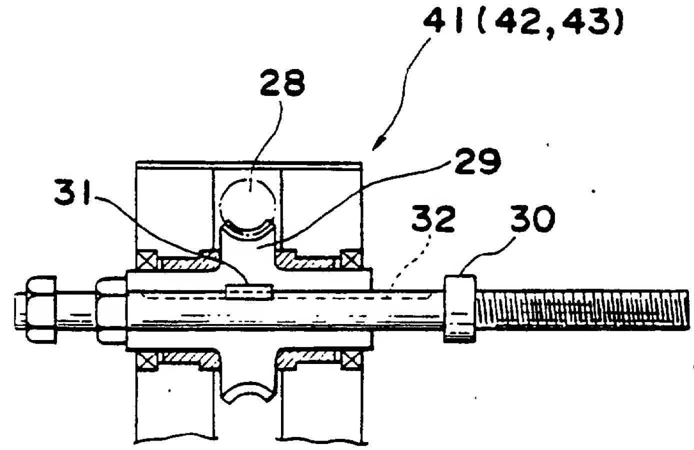


Fig. 2 PRIOR ART



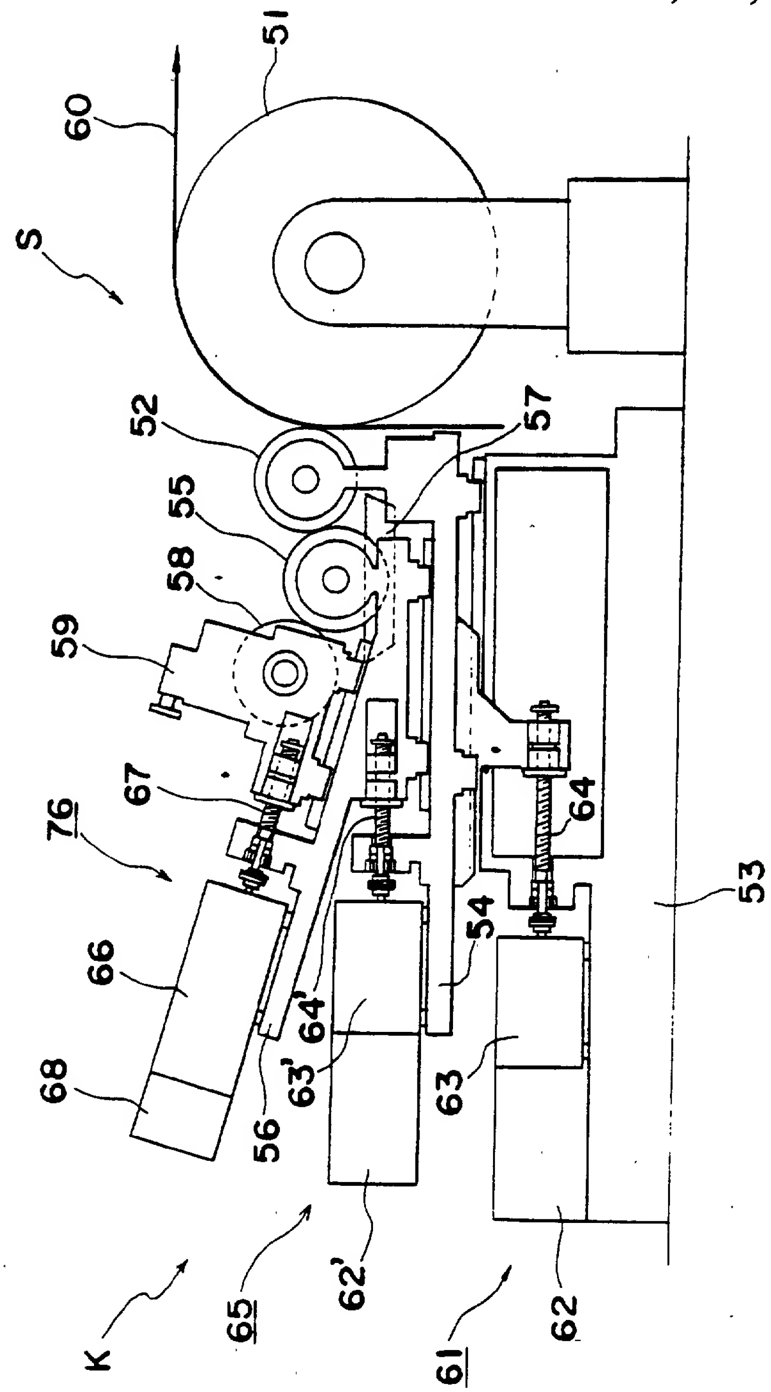
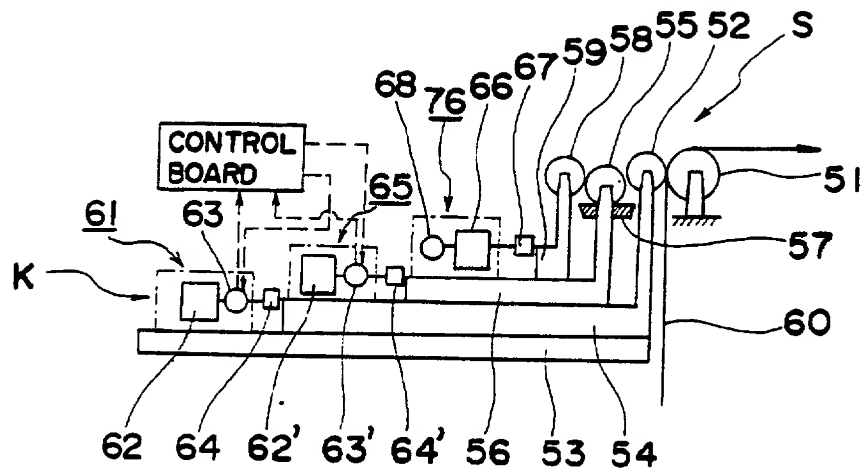


Fig. 3

Fig. 4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58
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Fig. 5

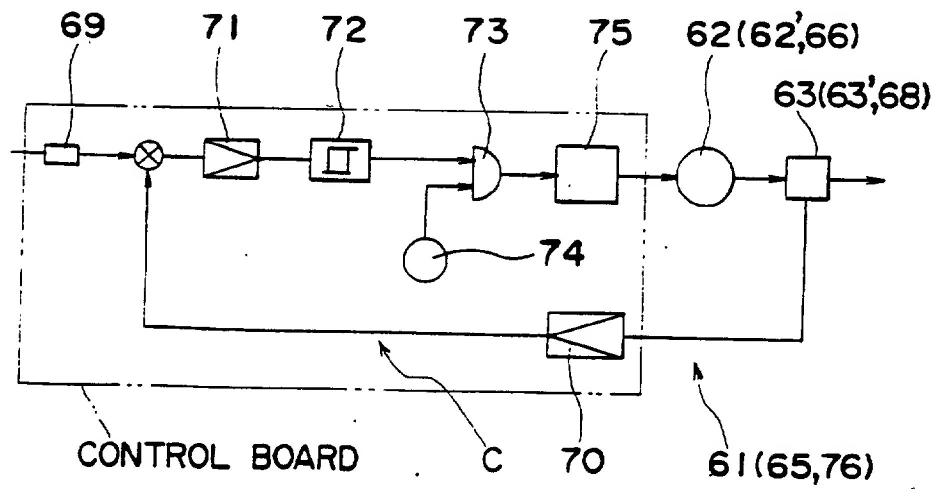
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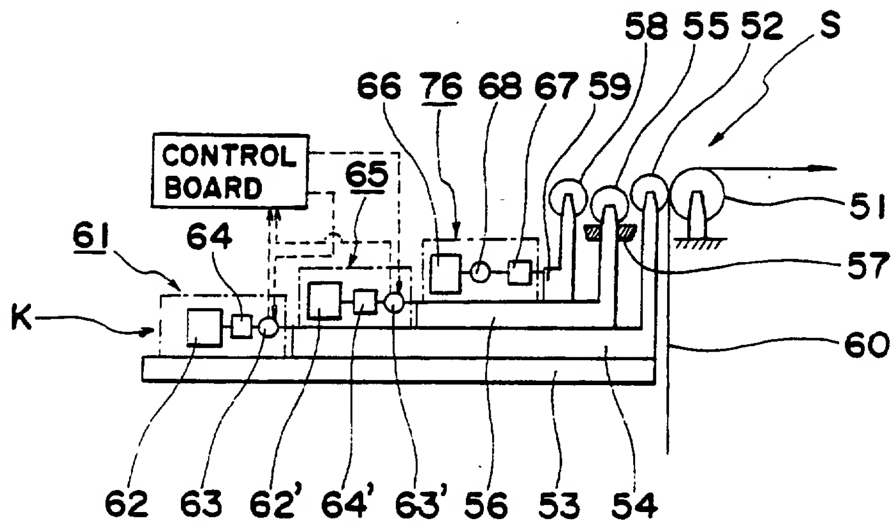
Fig. 6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DEVICE FOR AUTOMATICALLY CONTROLLING COATING AMOUNT FOR USE IN COATING MACHINE

This is a continuation of application Ser. No. 610,691, filed May 16, 1984, now abandoned.

BACKGROUND OF THE INVENTION

The present invention generally relates to a coating machine and more particularly, to a device for automatically controlling coating amount for use in the coating machine.

As shown in FIGS. 1 and 2, conventionally, in coating machines, it has been so arranged as disclosed, for example, in Japanese Laid-Open Utility Model Application No. 131869/1982 (Jikkaisho 57-131869) that an applicator roll 1 for applying paint to a sheet-like workpiece 22 pressed onto a backup roll 23 is secured to a first table 4. A pickup roll 2 for picking up paint stored in a pickup pan is secured to a second table 5, while a metering roll 3 is secured to a third table 6. The first table 4, the second table 5 and the third table 6 are slidably mounted on a base 19. Furthermore a first pressure adjusting mechanism 41 adjusts the contact pressure between the backup roll 23 and the applicator roll 1 by moving the first table 4 relative to the base 19. Mechanism 41 is mounted on the base 19 and engages the first table 4. A second pressure adjusting mechanism 42 adjusts the contact pressure between the applicator rolL1 and the pickup roll 2 by moving the second table 5 relative to the first table 4. Mechanism 42 is mounted on the first table 4 and engage the second table 5. A third pressure adjusting mechanism 43 adjust a contact pressure between the pickup roll 2 and the metering roll 3 by moving the third table 6 relative to the second table 5. Mechanism 43 is mounted on the second table 5 and engages the third table 6. Thus, thickness of a coating film on the workpiece 22 can be adjusted by operating the first, second and third pressure adjusting mechanisms 41, 42 and 43.

It should be understood that the applicator roll 1 is required to be quickly retracted away from the backup roll 23 just before a seam 26 of the workpiece 22 passes therebetween. To this end, a cylinder 20 is attached to the base 19 and is coupled with the first pressure adjusting mechanism 41 through a lever 33. Just before the seam 26 of the workpiece 22 passes between the backup roll 23 and the applicator roll 1, the first table 4 is quickly moved relative to the base 19 by the cylinder 20 in the leftward direction in FIG. 1, whereby the applicator roll 1 is quickly retracted away from the backup roll 23.

As best shown in FIG. 2, each of the first and second pressure adjusting mechanisms 41, 42 and 43 comprises a worm gearing composed of a worm 28 and a worm wheel 29, a rotary device (not shown) such as a hydraulic motor, a DC motor, etc. for driving the worm 28, a screw shaft 30 and a nut 14 (FIG. 1). The screw shaft 30 is unrotatably but axially movably mounted in the worm wheel 29 by a key 31 fitted into a key way 32 of the screw shaft 30 and is attached, at one end thereof, to the level 33. The first, second pressure adjusting mechanisms and the 41, 42 and 43 are operated by means of a manual handle based on skill of an operator. Thus, the prior art pressure and adjusting mechanisms have the disadvantages that skill of the operator is required for the operation and it is impossible to maintain each of the pressures between adjacent ones of the backup roll, the applicator roll, the pickup roll and the metering roll and the pickup roll at predetermined pressure values. Furthermore, the known pressure and adjusting mechanisms have such inconveniences that it is extremely difficult to operate them at higher speed and make them larger in size. Meanwhile, the known pressure adjusting mechanisms have been disadvantageous in that it is impossible to cope with minute changes in each pressure and the clearance due to rotation, swell, etc. of each roll. Moreover, the prior art pressure adjusting mechanisms have such a disadvantage that, in case each of the first, second and third tables are driven by a hydraulic motor or a DC motor through the worm gearing having a considerable play, it is impossible to accurately control each of contact pressures between adjacent ones of the rolls in forward and reverse rotations of the worm gearing. In addition, the known pressure adjusting mechanisms have such an inconvenience that, when a restrictive torque is continuously generated in the DC motor, its commutator is heated, thereby resulting in seizing thereof.

SUMMARY OF THE INVENTION

Accordingly, an essential object of the present invention is to provide an improved device for automatically controlling coating amount for use in a coating machine, in which each of contact pressures between adjacent rolls is detected as a detection signal, by a pressure sensor. The sensed pressure of each pair is compared with a preset value and then, a stepping motor is rotated forwardly or reversely through a step angle on the basis of a comparison signal which indicates the difference between the detection signal detected by the sensor and the present value such that each roll is moved toward or away from a corresponding neighboring one of the rolls. The roll movement is accomplished by a precision ball screw upon rotation of the stepping motor, whereby contact pressures between adjacent rolls, i.e., thickness of a coating film on a workpiece can be adjusted, with substantial elimination of the disadvantages inherent in conventional adjusting mechanisms of this kind.

Another important object of the present invention is to provide an improved device of the above prescribed type which is highly reliable in actual use and can be readily incorporated into coating machines and the like at low cost.

In accomplishing these and other objects according to one preferred embodiment of the present invention, there is provided an improved device for automatically controlling coating amount for use in a coating machine including a backup roll, an applicator roll, a pickup roll for picking up paint stored in a pickup pan, a base, a first table slidably mounted on said base, and a second table slidably mounted on said first table such that said applicator roll and said pickup roll are, respectively, secured to said first table and said second table, said device comprising: a first pressure adjusting mechanism for adjusting a contact pressure between said backup roll and said applicator roll such that said applicator roll is brought into pressing contact with said backup roll at a first preset value representing a first preset contact therebetween; and a second pressure adjusting mechanism for adjusting contact pressure between said applicator roll and said pickup roll such that said pickup roll is brought into pressing contact with said applicator roll at a second preset value representing a second preset

contact pressure therebetween; said first pressure adjusting mechanism further comprising: a first sensor for detecting a signal representing a contact pressure produced between said applicator roll and said backup roll; a first stepping motor arranged to be driven for rotation thereof in accordance with a difference between the signal detected by said first sensor and the first preset value; and a first precision ball bearing screw members for moving said first table relative to said base upon the rotation of said first stepping motor such that said applicator roll is moved toward or away from said backup roll; said second pressure adjusting mechanism further comprising: a second sensor for detecting a signal representing a contact pressure produced between said pickup roll and said applicator roll; a second stepping motor arranged to be driven for rotation thereof in accordance with a difference between the signal detected by said second sensor and the second preset value; and a second precision ball bearing screw member for moving said second table relative to said first table upon the rotation of said second stepping motor such that said pickup roll is moved toward or away from said applicator roll.

In accordance with the present invention, once the contact pressures have been set, it becomes possible to automatically adjust thickness of the coating film on the workpiece accurately by the use of the stepping motors and the precision ball bearing screw members both capable of performing forward or reverse movement through microns even if swell of the rolls takes place, and to precisely control the thickness of the coating film without shocks by varying the step advancing (or retracting) speed according to the program in case of temporary release of a seam of the workpiece to be coated.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and features of the present invention will become apparent from the following description taken in conjunction with the preferred embodiment thereof with reference to the accompanying drawings, in which:

FIG. 1 is a front elevational view of a prior art coating machine (already referred to);

FIG. 2 is a partially sectional view of a pressure adjusting mechanism employed in the prior art coating machine of FIG. 1 (already referred to);

FIG. 3 is a front elevational view of a coating machine in which a device for automatically controlling coating amount according to the present invention is incorporated;

FIG. 4 is a schematic view of the coating machine of FIG. 3;

FIG. 5 is a control circuit diagram of the device of FIG. 3; and

FIG. 6 is a view similar to FIG. 4, particularly showing a modification thereof.

Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals throughout several views of the accompanying drawings.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, there is shown in FIGS. 3 and 4, a coating machine S in which a device K for automatically controlling coating amount according to the present invention is incorporated. The coating machine S generally includes a backup roll 51, an applicator roll 52 made of elastic material such as rubber, a pickup roll 55 for picking up paint stored in a pickup pan 57, a metering roll 58, a base 53, a first table 54 slidably mounted on the base 53, a second table 56 slidably mounted on the first table 54, and a third table 59 slidably mounted on the second table 56 such that the applicator roll 52, the pickup roll 55 and the metering roll 58 are, respectively, secured to the first table 54, the second table 56 and the third table 59, with a sheet-like workpiece 60 subjected to coating being passed between the backup roll 51 and the applicator roll 52. It is to be noted that such an arrangement of the coating machine S is already known and each of the backup roll 51, the applicator roll 52, the pickup roll 55 and the metering roll 58 is driven by a hydraulic motor or a DC (or AC) motor (not shown).

Meanwhile, the device K of the present invention includes a first pressure adjusting mechanism 61 for adjusting a contact pressure between the backup roll 51 and the applicator roll 52, a second pressure adjusting mechanism 65 for adjusting contact pressure between the applicator roll 52 and the pickup roll 55 and a control board to be described later. The first clearance pressure mechanism 61 is arranged to move the first table 54 relative to the base 53 such that the applicator roll 52 is brought into pressing contact with the backup roll 51. Likewise, the second pressure adjusting mechanism 65 is arranged to move the second table 56 relative to the first table 54 such that the pickup roll 55 is brought into pressing contact with the applicator roll 52. More specifically, the first pressure adjusting mechanism 61 includes a stepping motor 62, a sensor 63 and a precision ball bearing screw member 64. The sensor 63 may be of any known contact pressure type. The stepping motor 62 and the contact pressure sensor 63 coupled to the stepping motor 62 are mounted on the base 53, while the precision ball bearing screw member 64 is mounted on the first table 54 so as to be coupled to the stepping motor 62 through the sensor 63. It is so arranged that the first table 54 is moved relative to the base 53 by the precision ball screw member 64 upon rotation of the stepping motor 62 such that the applicator roll 52 is moved toward or away from the backup roll 51. The sensor 63 and the precision ball bearing screw member 64 are operatively associated with the control board and can be exchanged, in position, with each other as shown in FIGS. 4 and 6. In the same manner as the first pressure adjusting mechanism 61, the second pressure adjusting mechanism 65 includes a stepping motor 62', a contact pressure 63' and a precision ball bearing screw member 64'. The stepping motor 62' and the sensor 63' coupled to the stepping motor 62' are mounted on the first table 54, while the precision ball bearing screw member 64' is mounted on the second table 56 so as to be coupled to the stepping motor 62' through the sensor 63'. It is so arranged that the second table 56 is moved relative to the first table 54 by the precision ball screw 64' upon rotation of the stepping motor 62' such that the pickup roll 55 is moved toward or away from the applicator roll 52. The sensor 63' and the precision ball bearing screw member 64' are operatively associated with the control board and can be exchanged, in position, with each other as shown in FIGS. 4 and 6.

The device K further includes a third pressure adjusting mechanism 76 for adjusting a third pressure between the pickup roll 55 and the metering roll 58. The third

pressure adjusting mechanism 76 is arranged to move the third table 59 relative to the second table 56 such that the metering roll 58 is brought into a pressure relative the pickup roll 55. The third pressure adjusting mechanism 76 includes a stepping motor 66, a precision ball bearing screw member 67 and a sensor 68, for instance, a roll clearance sensor. The stepping motor 66 and the sensor 68 composed of, for example, a pulse encoder coupled to the stepping motor 66 are mounted on the second table 56, while the precision ball bearing screw member 67 is mounted on the third table 59 so as to be coupled to the sensor 68 through the stepping motor 66. The stepping motor 66 and the sensor 68 can be exchanged, in position, with each other as shown in FIGS. 4 and 6. It is so arranged that the third table 59 is moved relative to the second table 56 by the precision ball bearing screw member 67 upon the rotation of the stepping motor 66 such that the metering roll 58 is moved toward or away from the pickup roll 55. The clearance between the two controls the coating thickness being applied to material 60. It is to be noted that the precision ball bearing screw members 64, 64' and 67 are arranged to directly move, upon rotation thereof, the first, second and third tables 54, 56 and 59, respectively and, for example, NSK precision ball bearing screw members (name used in trade and manufactured by Nippon Seiko K.K., Japan) can be employed therefor.

Meanwhile, as shown in FIG. 5, the control board includes a pair of control circuits C connected to the first pressure adjusting mechanism 61 and the second pressure adjusting mechanism 65, respectively. Namely, when a preset contact pressure to be applied from the applicator roll 52, through the workpiece 60, to the backup roll 51 has been given to a presetter 69 as a preset signal in the first pressure adjusting mechanism 61, a contact pressure applied from the applicator roll 52 to the backup roll 51 is detected as a reaction force of elastic material of the applicator roll 52 and thus, a contact pressure between the applicator roll 52 and the backup roll 51 is detected through the precision ball bearing screw member 64 by the sensor 63. This detection signal of the sensor 63 is transmitted via an amplifier 70 for the sensor 63 so as to be compared with the preset signal from the presetter 69 and then, is applied to a comparator circuit 72 by way of a preamplifier 71. In the case where a difference between the detection signal of the sensor 63 and the preset signal from the presetter 69 exceeds a predetermined value, a comparator signal is delivered from the comparator circuit 72 and then, the gate circuit 73 is opened, so that a pulse signal is inputted to a driver unit 75 on the basis of a frequency of an oscillator 74 connected to the gate circuit 73, the frequency being varied by a preset program. Thus, the stepping motor 62 is rotated forwardly or reversely at a given programmed speed through a predetermined angle by a power signal from the drive unit 75. Upon the rotation of the stepping motor 62, the first table 54 is moved relative to the base 53 by the precision ball bearing screw member 64 such that the applicator roll 52 is moved toward or away from the backup roll 51. Subsequently, a signal indicating a change in contact pressure between the backup roll 51 and the applicator roll 52 due to movement of the applicator roll 52 toward or away from the backup roll 51 is again fed back to the control circuit C such that the applicator roll 52 is brought into pressing contact with the backup roll 51 automatically at a preset value based on the contact pressure. Consequently, the backup roll 51 and the applicator roll 52 are maintained at the preset contact pressure therebetween.

Furthermore, if a change in a roll diameter due to replacement of the applicator roll 52, etc. causes difference in the amount of movement between the tables, the pressure between the rolls, when the sensor 63 detects the given contact pressure, is automatically memorized and is designated as an original point of the pressure. Thus, the relation in respect of coating conditions is always kept if the movement is repeated.

Adjustments between the applicator roll 52 and the pickup roll 55 and between the pickup roll 55 and the metering roll 58 are performed in the same manner as described above.

In the event that the coating operation of the coating machine S is started or stopped by moving the first table 54 or that a seam of the workpiece 60 to be coated is temporarily advanced or retracted for cleaning, the roll (contact pressure) between the applicator roll 52 and the backup roll 51 is adjusted by the first pressure adjusting mechanism 61 by moving the first table 54 at said programmed speed.

The second table 56 and the third table 59 are also moved in the same manner as the above described first table 54.

As is clear from the foregoing description, in accordance with the present invention, the contact pressure applied from the applicator roll to the backup roll, the contact pressure applied from the pickup roll to the applicator roll and the pressure between metering roll and the pickup roll is detected by the appropriate sensors. Thereafter, this is compared with the preset value such that the precision ball bearing screw member is driven through the stepping motor, so that the first table and/or the second table is moved relative to the base and/or the first table, whereby the coating amount on the workpiece is automatically controlled precisely.

Furthermore, in accordance with the present invention, since each of the first table and the second table is moved automatically by the use of the stepping motor and the precision ball bearing screw both free from play, it becomes possible to accurately control the thickness of the coating film on the workpiece.

Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be noted here that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention, they should be construed as included therein.

What is claimed is:

1. A device for automatically controlling the coating amount of paint deposited on a continuous strip moving between a pair of circular rolls in a coating machine including at least three tandemly located circular rolls that are in continuous adjustable contact with the next adjacent roll in the tandem sequence, said rolls including a circular backup roll and a circular applicator roll of an elastic material with a strip to be coated moveable therebetween, a circular pickup roll in contact with said elastic applicator roll for picking up paint stored in a pickup pan, and a circular metering roll in contact with the circular pickup roll, a fixed base, a first table slidably mounted on said base, and a second table slidably mounted on said first table such that said circular applicator roll and said circular pickup roll are, respectively,

slidably secured to said first and said second table for a continuous and automatically adjustable pressure contact between all of said circular rolls, said device comprising:

a present pressure control program for automatically and continuously controlling the pressure adjustment between adjacent individual ones of said above-claimed circular rolls to lie within an equilibrium condition within a predetermined range of pressure;

means for emitting a first preset signal indicative of a desired preset contact pressure range between said circular backup roll and said circular elastic applicator roll while said strip to be coated is moved therebetween;

a first pressure adjusting mechanism coupled between said fixed base and said first table for continuously and automatically adjusting the contact pressure applied from said applicator roll through said backup roll such that said applicator roll is slidably brought into pressing elastic contact with said backup roll at a pressure lying within said predetermined equilibrium pressure range;

means for emitting a second preset signal indicative of a range of desired preset contact pressure between said applicator roll and said pickup roll;

a second pressure adjusting mechanism carried by said first table and coupled between said first and second tables for continuously and automatically adjusting the pressure between said applicator roll and said pickup roll such that said pickup roll is slidably brought in pressing contact with said applicator roll at a pressure lying within said second pressure range therebetween;

said first pressure adjusting mechanism further comprising;

a first sensor in combination with a first precision ball bearing screw member for detecting a first signal representing a contact pressure reaction force of said elastic applicator roll material produced between said applicator roll and said backup roll;

a first comparator circuit means for generating and storing said first detected signal, and means associated with said first comparator circuit for emitting a first difference signal indicative of the difference, if any, between said first preset value range and said first sensor's detected signal value;

a first stepping motor arranged to be intermittently driven through step angle rotation thereof by said first difference signal when said first sensed signal is outside said predetermined range and in accordance with said preset pressure control program;

said first precision ball bearing screw member being further adapted for moving said first table relative to said base upon the intermittent rotation of said first stepping motor such that said applicator roll is slideably moved by steps toward or away from said backup roll at a speed controlled by said preset pressure control program until said desired and controlled preset pressure is achieved within said predetermined range and the reaction force sensed by said first sensor is at a null condition that stops further rotation of said first stepping motor;

said second pressure adjusting mechanism further comprising;

a second sensor in combination with a second precision ball bearing screw member detecting a second signal representing a contact pressure reaction force of said elastic applicator roll material produced between said pickup roll and said elastic applicator roll;

a second comparison circuit means for generating and storing said second sensor's detected signal, and means associated with said second comparator circuit for emitting a second difference signal indicative of the difference, if any, between said second preset value range and said second sensor's detected value;

a second stepping motor arranged to be intermittently driven through step angle rotation thereof in accordance with said second difference signal when said second signal is outside said second predetermined range and in accordance with said preset pressure control program; and

said second precision ball bearing screw member being further adapted for moving said second table relative to said first table upon the intermittent rotation of said second stepping motor such that said pickup roll is slidably moved by steps toward or away from said applicator roll at a speed controlled by said preset pressure control program - until said second desired and controlled preset pressure is achieved and said reaction force sensed by said second sensor is at a null condition that stops further rotation of said second stepping motor.

2. A device as claimed in claim 1, further including a third table slidably mounted on said second table such that said metering roll is secured to said third table.

3. A device as claimed in claim 1, wherein each of said first pressure adjusting mechanism and said second pressure adjusting mechanism further comprises a presetter for defining each of the first preset contact pressure and the second preset contact pressure, and wherein said first and second comparators include a series connected circuit having a coincidence gate and a driver unit, together with an oscillator adapted to feed driving pulses through said gate and driver unit to said stepping motor circuit when said gate circuit is in an enabled condition.

4. A device for automatically controlling coating amount for use in a coating machine including a circular backup roll mounted for rotation on a backup axle, and an elastic circular applicator roll mounted for rotation on an applicator axle, a circular pickup roll mounted for rotation on a pickup axle for picking up paint stored in a pickup pan, a base, a first table slidably mounted to move said applicator roll and its axle on said base, and a second table slidably mounted on said first table to move said pick up roll and its axle along with said second table such that said elastic applicator roll and said pickup roll are, respectively, secured to and move with said first table and with said second table, respectively, said device comprising:

a first contact adjusting mechanism for automatically and continuously adjusting a contact pressure between said backup roll and said elastic applicator roll by moving the first table, the applicator roll and its axle such that said elastic applicator roll is automatically brought into pressing contact with said backup roll at a first preset value representing a first preset contact pressure therebetween; and

a second contact adjusting and continuously mechanism moveable both on said first contact adjusting mechanism and also automatically adjustable independently from said first adjusting mechanism, for

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automatically adjusting a contact pressure between said elastic applicator roll and said pickup roll by moving the pickup roll and its axle such that said pickup roll is brought into pressing contact with said applicator roll at a second preset value representing a second preset contact pressure until said elastic applicator roll is in a continuous equilibrium state between said backup and said elastic pickup rolls in the presence of swells in said rolls or a seam in said workpiece being coated while said automatic adjustment is taking place.

5. A device in accordance with claim 4 wherein said first contact adjusting mechanism further comprises:

a first sensor for detecting a first signal representing a contact pressure produced between said elastic applicator roll and said backup roll; and

a first stepping motor arranged to be driven for rotation in accordance with said difference signal between the first signal detected by said first sensor and the first preset value.

6. A device in accordance with claim 5 and further comprising:

a first precision ball screw for moving said first table relative to said base upon the rotation of said first stepping motor such that said elastic applicator roll is moved toward or away from said backup roll.

7. A device in accordance with claim 6 wherein said second contact adjusting mechanism further comprises:

a second sensor for detecting a second signal representing a contact pressure produced between said pickup roll and said elastic applicator rolls; and

a second stepping motor arranged to be driven for rotation in accordance with said difference signal between the second signal detected by said second sensor and the second preset value.

8. A device in accordance with claim 7 and further comprising:

a second precision ball bearing screw member for moving said second table relative to said first table upon the rotation of said second stepping motor such that said pickup roll is moved toward or away from said elastic applicator roll.

9. A device as claimed in claim 4 and further including:

a metering roll; and

a third table slidably mounted on said second table such that said metering roll is secured to said third table and is adjustable toward or away from said pickup roll.

10. A device as claimed in claim 9, and further comprising a third pressure adjusting mechanism, said third pressure adjusting mechanism comprising:

a third sensor for detecting a signal representing contact pressure produced between said metering roll and said pickup roll; and

a third stepping motor arranged to be driven for rotation thereof in accordance with a difference between the signal detected by said third sensor and the third preset value.

11. A device in accordance with claim 10 and further comprising:

a third precision ball bearing screw member for moving said third table relative to said second table upon the rotation of said third stepping motor such that said metering roll is moved toward or away from said pickup roll.

12. A device as claimed in claim 11 wherein each of said first and second pressure adjusting mechanisms each further comprises:

a presetter for defining each of the first preset contact pressure and the second preset contact pressure; and

wherein said first and second comparators each include a series-connected circuit having a coincidence gate and a driver unit, with an oscillator adapted to feed driving pulses through said coincidence gate and the driver unit to each of said stepping motor circuits when said coincidence gate circuit is in an enabled condition.

13. In a control device for automatically controlling the amount of paint applied to an elongated sheet having a backup roll supporting the sheet which contains an enlarged seam therein, an applicator roll for applying the paint, a pickup roll for picking up the paint stored in a pickup pan, a support base, a first table slidably mounted on said base, and a second table slidably mounted on said first table such that said applicator roll and said pickup roll are, respectively, secured to said first table and said second table, the improvement comprising:

an elasticized coating on said applicator roll with said elasticized applicator roll being positioned in tandem with said other rolls and located between said pickup and said backup rolls;

a first contact adjusting mechanism for adjusting a contact pressure between said backup roll and said elasticized applicator roll such that said applicator roll is brought into pressing contact with said backup roll at a first preset value representing a first preset contact pressure therebetween;

a second contact adjusting mechanism for adjusting a contact pressure between said elasticized applicator roll land said pickup roll such that said pickup roll is brought into pressing contact with said applicator roll at a second preset value representing a second preset contact pressure therebetween;

means for storing and generating electrical signals representative of said first and second preset contact pressure values;

said first contact adjusting mechanism further consisting of a first sensor means for producing a first signal representing the actual contact pressure between said elasticized applicator roll and said backup roll, and a first stepping motor arranged to be electrically driven for rotation thereof in accordance with a difference signal between the actual contact pressure signal detected by said first sensor and the first preset value;

a first precision member for automatically moving both said first table and said second contact adjusting mechanism relative to said base in response to said first difference signal by rotation of said first stepping motor such that said elasticized applicator roll is moved toward or away from said backup roll;

said second contact adjusting mechanism further consisting of;

a second sensor means for producing a second signal representing a contact pressure produced between said pickup roll and said elasticized applicator roll;

a second stepping motor arranged to be electrically driven for rotation thereof in accordance with a difference between the second signal detected by said second sensor and the second preset value; and

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a second precision member for automatically moving said second table relative to said first table upon the rotation of said second stepping motor such that said pickup roll is moved toward or away from said elasticized applicator roll, said adjustments of the respective first and second contact adjusting mechanisms independently and automatically being implemented continuously to place all of said tandem rolls in an equilibrium state that assures a constant amount of paint being applied to the sheet in the presence of said seam in another sheet, which seam disrupts the pressure between said tandem rolls were it not for the continuous adjustment of said first and second contact adjustment mechanisms.

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United States Patent [19]

Simeth

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[45] Date of Patent: Nov. 28, 1989

[54] CHANGE-OVER INKING UNIT OF A SHEET-FED ROTARY PRESS

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[22] Filed: Jan. 10, 1989

Related U.S. Application Data

[63] Continuation of Ser. No. 90,117, Aug. 27, 1987, abandoned.

[30] **Foreign Application Priority Data**

Aug. 27, 1986 [DE] Fed. Rep. of Germany 3629081

[51] Int. Cl.⁴ B41F 31/10; B41F 31/30

[52] U.S. Cl. 101/350; 101/352

[58] Field of Search 101/349, 351, 352, 350, 101/148, 363, 207, 208-210

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Primary Examiner—J. Reed Fisher
Attorney, Agent, or Firm—Leydig, Voit & Mayer

[57] **ABSTRACT**

A sheet feed rotary press having a main ink feed unit and a plate cylinder, at least one of a plurality of transfer and applicator rolls coupled between the main ink feed unit and the plate cylinder being moveable to an inoperative position for selectively isolating a relatively short length group of applicator and transfer rolls from the main ink feed unit, and an additional quick acting ink feed unit that is selectively moveable into engagement with the short length roll group for supplying lesser quantities of ink to the plate cylinder through a shortened path via the short length roll group.

5 Claims, 1 Drawing Sheet

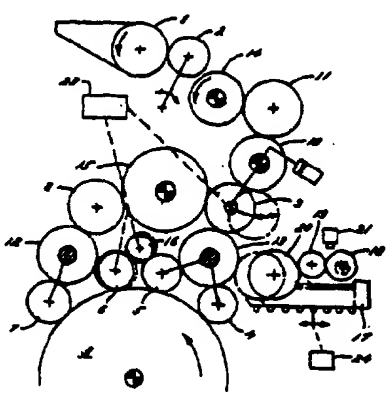
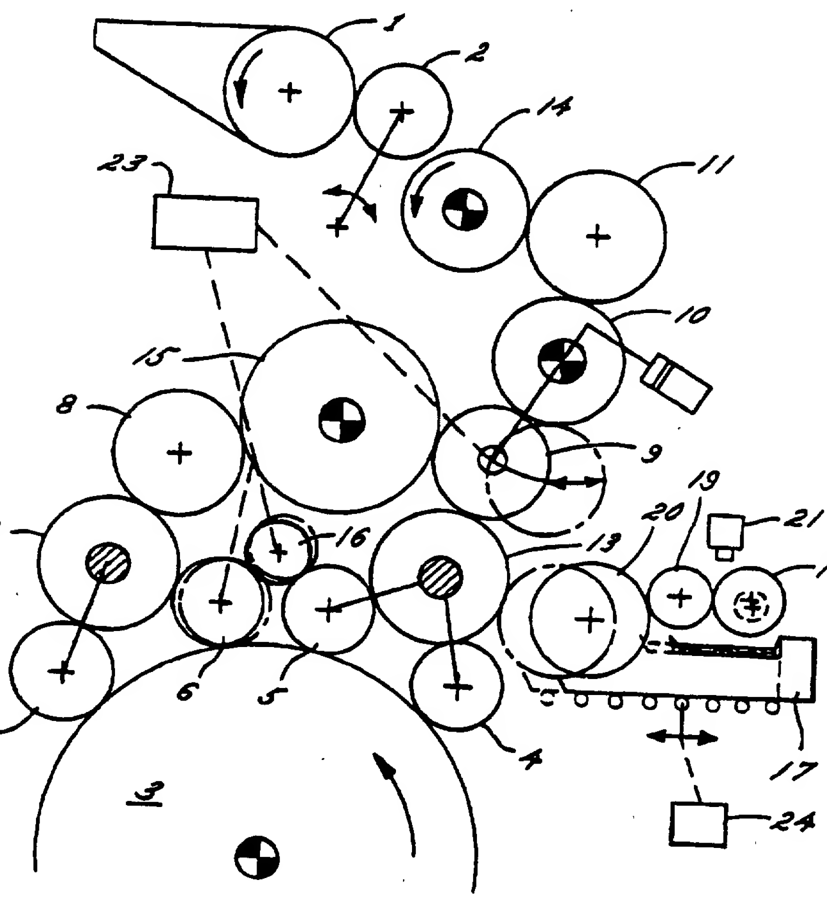


FIG. 1



CHANGE-OVER INKING UNIT OF A SHEET-FED ROTARY PRESS

This application is a continuation of application Ser. No. 090,117, filed Aug. 27, 1987, now abandoned.

The present invention relates to change over inking units for sheet feed rotary presses.

Devices of this kind are known, as described in the introductory portion of German patent AS 1 234 739. A disadvantage of these known devices is that upon the interruption or completion of a printing operation they are not adapted to quickly supply small amounts of ink to a relatively few sheets, as commonly required for proof situations, for example, to assess register or control adjustments or the like. Known change over ink units react relatively slowly, requiring the ink passage through a long line of transfer rolls to build up the requisite ink-water equilibrium and to establish the desired layer density for transfer to the plate cylinder.

It is an object of the present invention to provide a change over inking system adapted to obviate disturbances of the ink-water equilibrium or ink layer density in the ink transfer rolls, as commonly occurs in the known change over inking units during run-on following completion or interruption of a printing operation.

Another object to provide a change over inking system as characterized above that includes a more quickly responsive short length inking unit that can be used for proof situations and minimum ink consumption printing when the main inking unit of the press is not operating or is unneeded.

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings, in which:

FIG. 1 is a diagrammatic illustration of an illustrative sheet fed rotary printing press having a change over inking unit embodying the present invention.

While the invention is susceptible of various modifications and alternative constructions, a certain illustrated embodiment thereof has been shown in the drawings and will be described below in detail. It should be understood, however, that there is no intention to limit the invention to the specific form disclosed, but on the contrary, the intention is to cover all modifications, alternative constructions and equivalents falling within the spirit and scope of the invention.

Referring now more particularly to the drawings, there is shown an illustrative sheet fed rotary printing press embodying the invention. The printing press includes a plurality of applicator rolls 4–7 and plurality of transfer rolls 8–16 which are interposed between a first or main ink feeder, for example, a duct roll 1 and a vibrator roll 2, and the printing forme, for example, on a plate cylinder 3. During normal printing operations, when normal to maximum ink consumption is required, ink is transferred from the duct roll 1 and vibrator roll 2, through the transfer rolls 14, 11 and 10 to the transfer roll 9. From the transfer roll 9, ink is transferred through the transfer roll 13 to the applicator rolls 4 and 5 and also through the transfer rolls 15, 8 and 12 to the applicator rolls 5 and 6. The transfer roll 16 in this case is a connecting roll between applicator rolls 5 and 6. As is known in the art, such ink transfer smooths the ink to the desired density for transfer to the applicator rolls and printing form.

Selected groups of the transfer and applicator rolls preferably remain permanently engaged at all times. In this instance, transfer rolls 14, 11 and 10 are permanently engaged, transfer rolls 15, 18 and 12 are permanently engaged with applicator roll 7, and transfer rolls 13, 16 and applicator rolls 4, 5, and 6 remain engaged at all times.

Selectively operable means are provided for interrupting the flow of ink to the applicator rolls 4–7 from the main inking unit 1, 2 upon cessation or completion of the printing operation. In this instance, means, diagrammatically indicated at 23, are provided for moving the transfer roll 9 to an inoperative position disengaged from transfer rolls 15 and 13, as shown in phantom, and for moving the transfer roll 16 and applicator roll 6 out of engagement with transfer roll 12, while they respectively maintain contact with the cylinder roll 3 and applicator roll 5, again as shown in phantom. It will be appreciated that such moving means may be of a known type, such as eccentric mountings for the movable rolls, pneumatic cylinders, pivoted levers or the like, which are effective to separate transfer rolls 9 and 13 and rolls 12 and 6 to in effect isolate a relatively short length roll group 4–6, 13 and 16 from the main ink feeder. It will be understood that the rolls 4–6, 13 and 16 which form the short length inking roll group could be mounted in an inking unit frame, which, for example, could be pivoted about a central axis for the plate cylinder 3 or otherwise be moved as a unit during a change over operation.

In accordance with the invention, additional ink feeding means is provided which is selectively movable into operative relation with the short length roll group for more quickly providing relatively small amounts of ink to the plate cylinder, such as during run-on following cessation of a printing operation. To this end, an additional feeder 17 is provided which preferably is in the form of a quick acting ink unit comprising a dispensing roll 18, transfer rolls 19, 20 and a self-regulating ink feed facility 21. The separate quick acting inking unit is adapted to provide the desired ink-water equilibrium for minimum ink consumption much more rapidly than the main ink feeder so that it is particularly adaptable for proof work or other reduced ink consumption printing.

In keeping with the invention, the quick acting unit 17 is mounted for translational movement between a retracted or inoperative position, shown in solid lines in the drawing, to an in operative position engaging the transfer roll 13, as shown in phantom. Appropriate means, such as diagrammatically indicated at 24, may be provided for effecting such movement. Alternatively, the quick acting inking unit could be mounted for pivotable movement between operative and disengaged positions.

During normal operation of the sheet fed rotary printing press, with the quick acting inking unit in a retracted position, and with the rolls 9 and 6 in respective operative engagement with the transfer rolls 15 and 12, ink is supplied to the plate cylinder from the main inking unit for printing with normal to maximum ink consumption. Upon cessation of a normal printing operation, the transfer roll 9 may be moved to its disengaged position from transfer rolls 15 and 13, as shown in phantom in FIG. 1, and the applicator roll 6 is moved to a disengaged position from transfer roll 12, so as to interrupt the flow of ink from the main inking unit 1, 2 to the plate cylinder 3. At the same time, the quick acting inking unit 17 is moved into operative engagement with

the transfer roll 13, so as to rapidly supply minimum quantities of ink to the plate cylinder for proof work, or reduced ink consumption printing. To resume normal printing, the rolls 9 and 6 again are moved into operative engagement with the main ink transfer line and the quick acting inking unit moved to its retracted position. However, when the printing operation requires substantially no ink, the change over to the main inking unit operation need not be required and only the short inking unit may be used. To prevent disturbances of the equilibrium state or of the ink layer thickness gradient of the transfer rolls 8–15 in response to an interruption of run-off in the main inking unit operation, the change over to the short inking unit operation can be coupled by known control means to the cessation of printing.

I claim:

1. A sheet-fed rotary press comprising

main ink feed means,

a plate cylinder,

a plurality of transfer and applicator rolls coupled between said main ink feed means and said plate cylinder for defining an ink flow path for transferring ink in a downstream direction from said main ink feed means to said plate cylinder during printing operations, means mounting at least one of said transfer rolls which define said flow path for movement between an operative position in said flow path and an inoperative position out of engagement with said transfer and applicator rolls downstream thereof, means for selectively moving said at least one transfer roll from said operative position to said inoperative position for interrupting the transfer of ink from said main ink feed means to said plate cylinder and for isolating a short length roll group comprising only a portion of said plurality of transfer and applicator rolls, and

additional ink feed means, and means for selectively moving said additional ink feed means from an inoperative position out of engagement with said short length roll group to an operative position engaging said short length roll group for supplying ink to said plate cylinder through a shortened flow path via said short length roll group.

2. The rotary printing press of claim 1 in which the transfer and applicator rolls of said short length group remain engaged with each other at all times.

3. The rotary printing press of claim 1 in which said transfer and applicator rolls include a plurality of applicator rolls, means mounting at least one of said applicator rolls for movement between an operative position in said ink flow path to an inoperative position out of engagement with other transfer and applicator rolls of said flow path, and means for simultaneously moving said at least one transfer roll and said at least one applicator roll from said operative to said inoperative positions for interrupting the supply of ink from said main ink feed means to said short length roll group.

4. The rotary printing press of claim 1 in which said additional ink feed means is operable for supplying lesser quantities of ink than said main ink feed means.

5. The rotary printing press of claim 4 in which said additional ink feed means is mounted for translational movement relative to said short length roll group.

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United States Patent [19]
Sarda

[11] **Patent Number: 4,889,051**
[45] **Date of Patent: Dec. 26, 1989**

[54] **REMOVABLE INKING DEVICE FOR OFFSET PRESS**

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[21] Appl. No.: **224,071**

[22] Filed: **Jul. 25, 1988**

[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[4] **B41F 7/06; B41F 7/10;** B41F 13/40

[52] **U.S. Cl.** **101/77;** 101/137; 101/177; 101/247

[58] **Field of Search** 101/177, 181, 182, 185, 101/184, 136, 137, 139, 140, 142, 143, 144, 145, 76, 77, 91, 247

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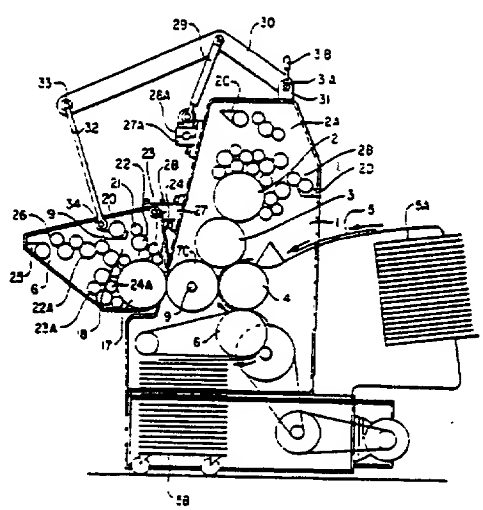
Primary Examiner—J. Reed Fisher

[57] **ABSTRACT**

A detachable printing unit for offset printing presses, which can be incorporated during their manufacture or fitted to existing presses, said unit being defined in that it is composed of an independent inking module 16 (FIG. 3) comprising all the components required for effecting in chronological operating order the moistening and inking of an offset plate ready for printing on a blanket, and a likewise independent detachable blanket cylinder 7C. One embodiment of the invention is defined in that the numbering device with which the press is equipped (FIG. 6, View B) is replaced by the blanket cylinder (FIG. 7, View B) of the printing unit working with the inking module 16 (FIG. 3), and use is made of the drive mechanism 8 (FIG. 6) and pressure adjustment mechanism 9B provided in the press to obtain for each printing cycle, instead of the numbering, an additional color obtained by color superimposition with the aid of the pressure cylinder 4. In the other form of the invention the same inking module, disposed in another position in the press, works conjointly with the blanket cylinder 3 of the press to enable for each printing cycle an additional color and optionally letterpress numbering or an additional letterpress color to be achieved.

6 Claims, 10 Drawing Sheets



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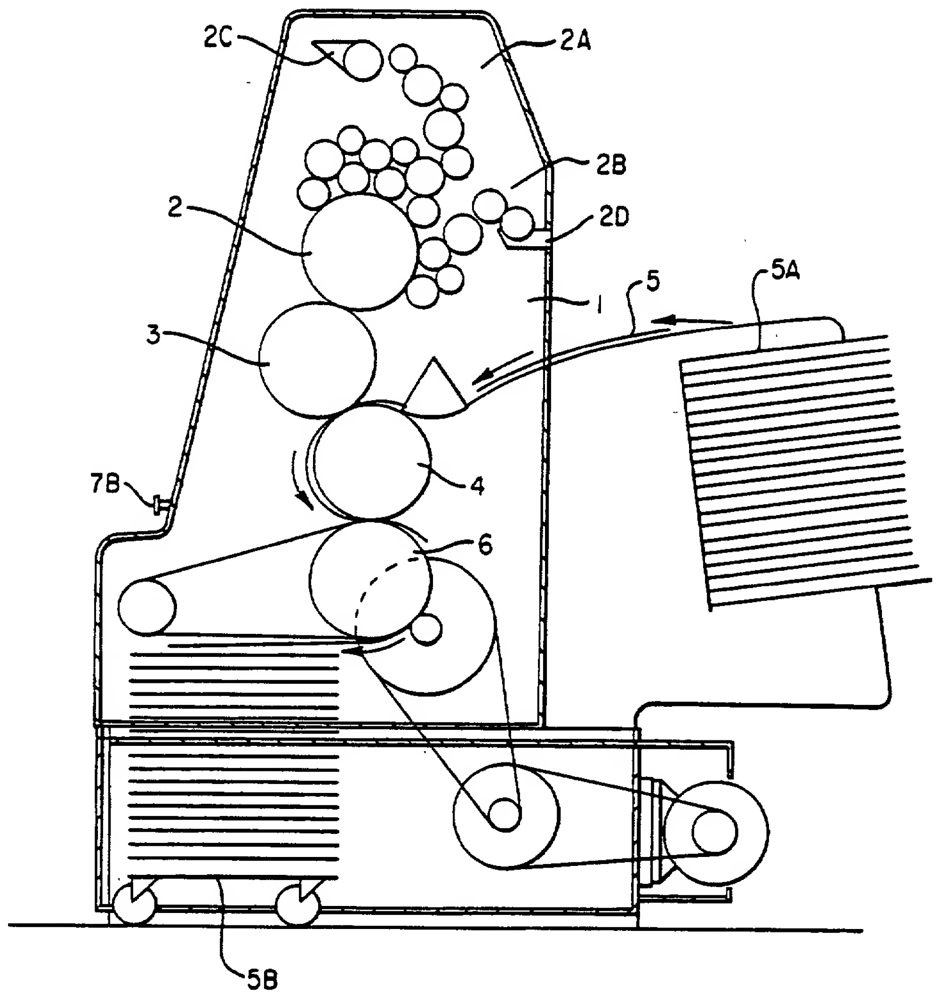


FIG. 1
PRIOR ART

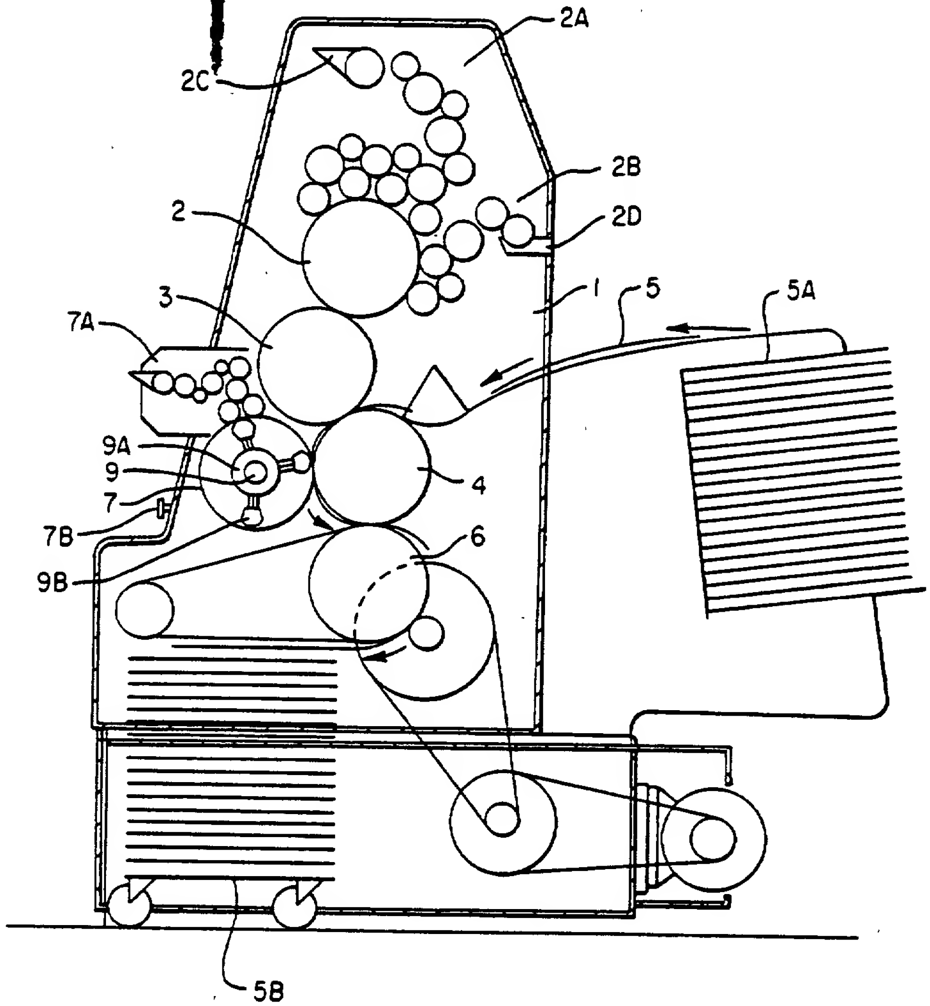
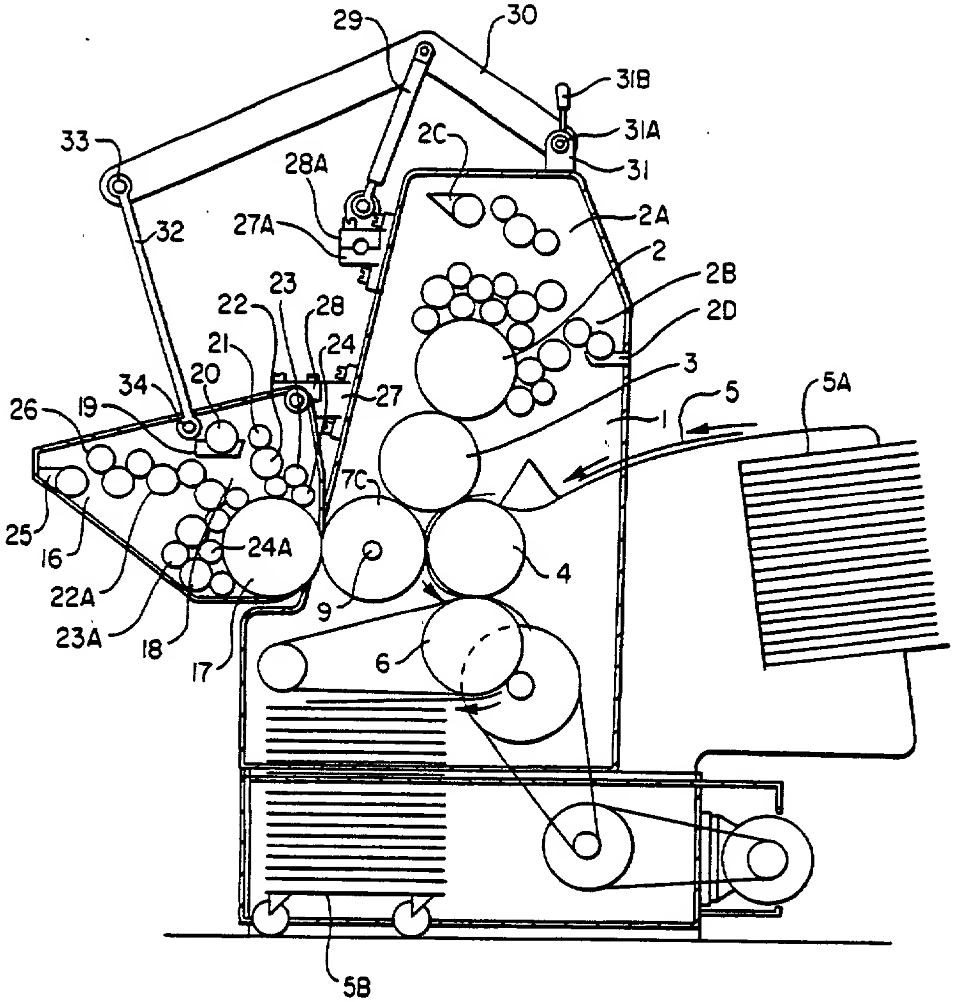


FIG. 2
PRIOR ART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2D
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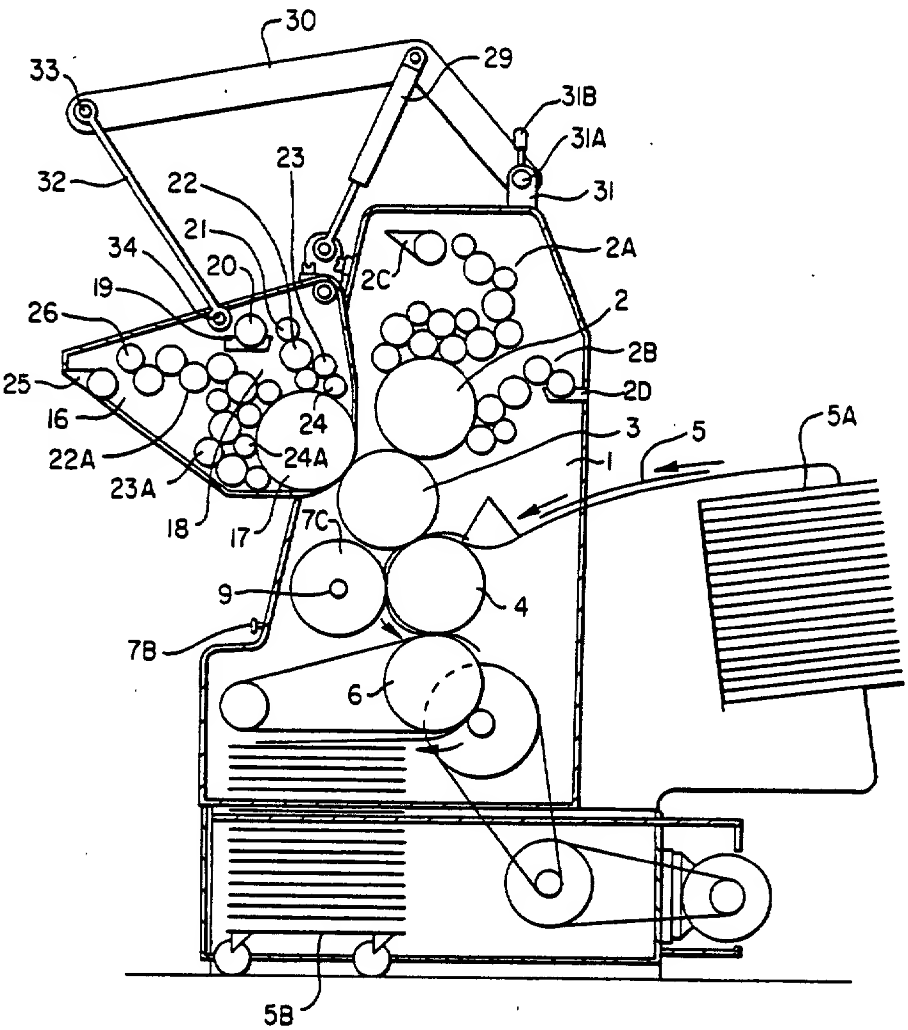
24
3
20
5
5A
34
27
26
19
1
7C
25
24A
16
4
22A
9
23A
18
6
17
5B

FIG. 3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2D
16
24
3
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7C
9
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7B
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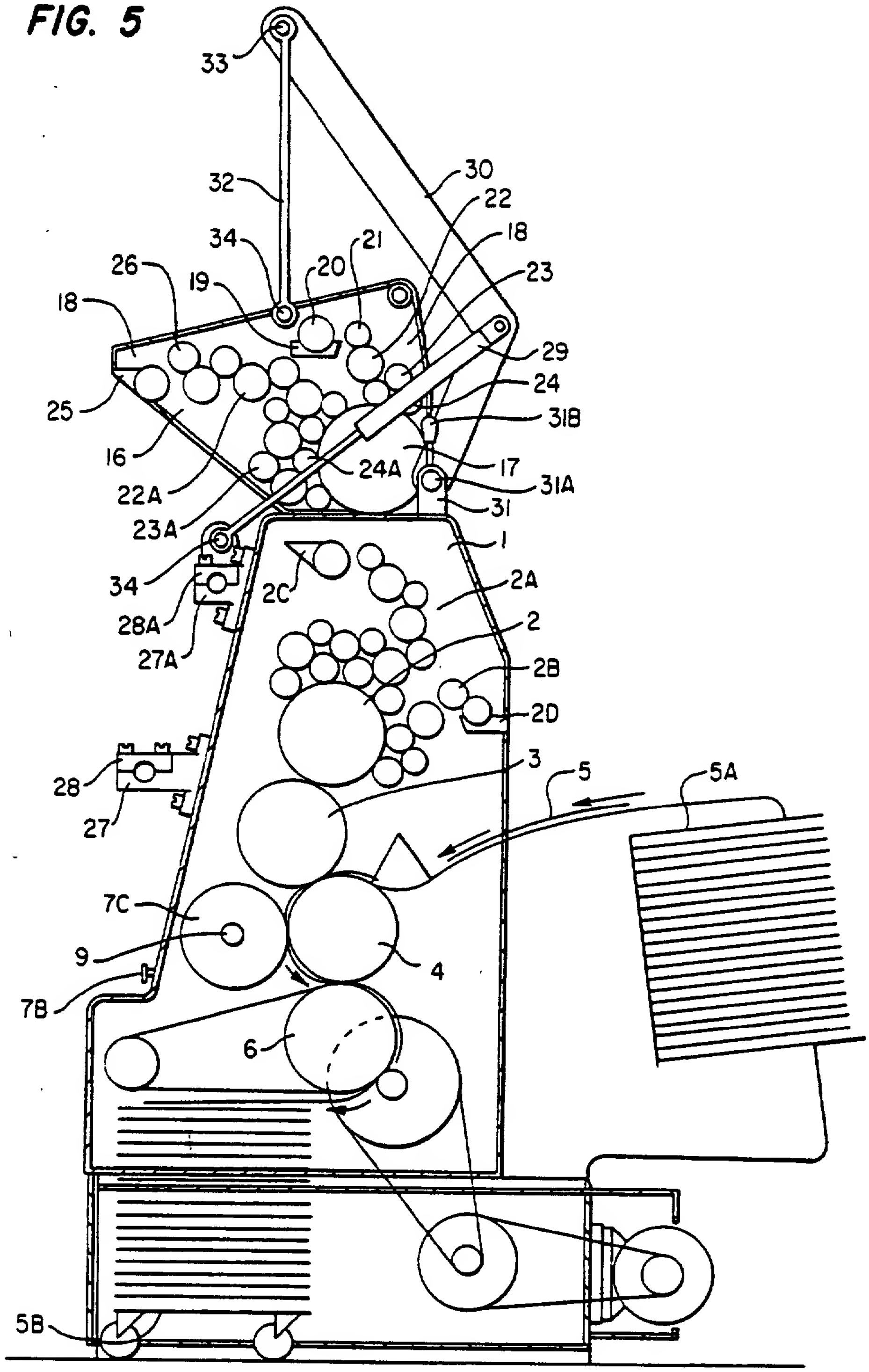
FIG. 4

FIG. 5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31
23A
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34
2A
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7B
6
5B

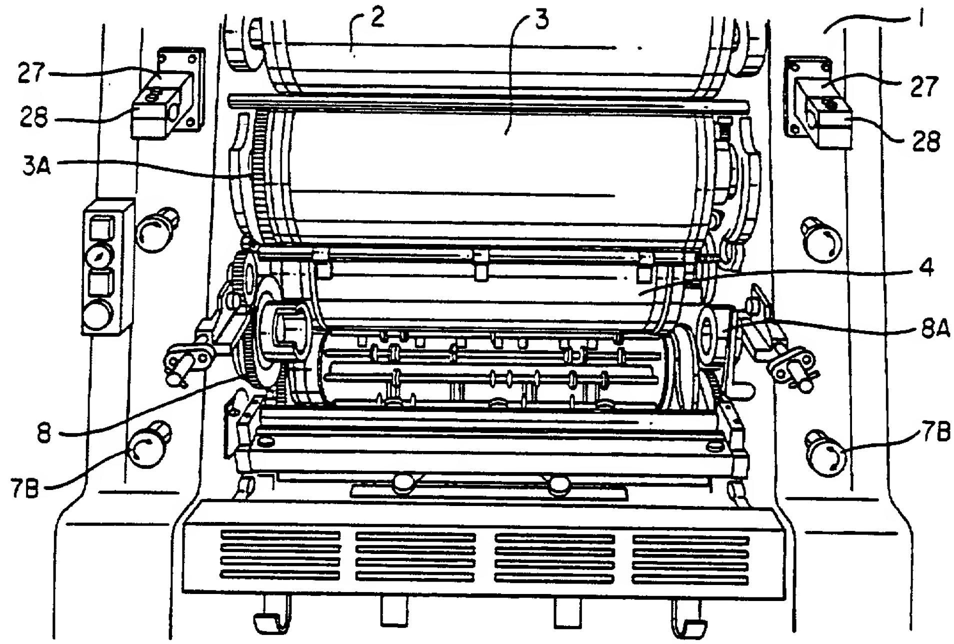

FIG. 6A
PRIOR ART

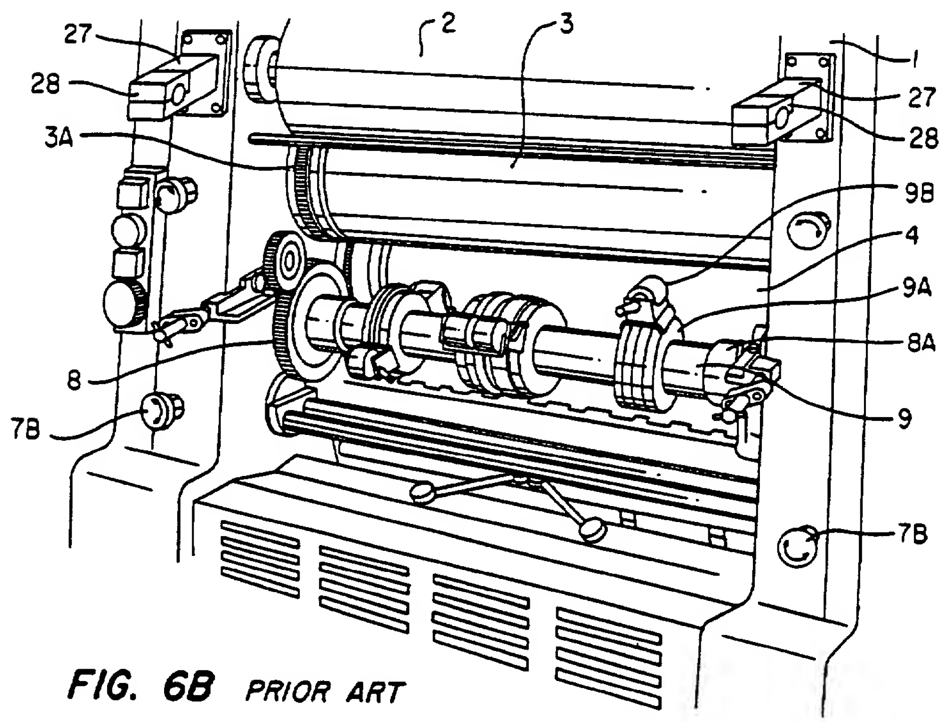

FIG. 6B PRIOR ART

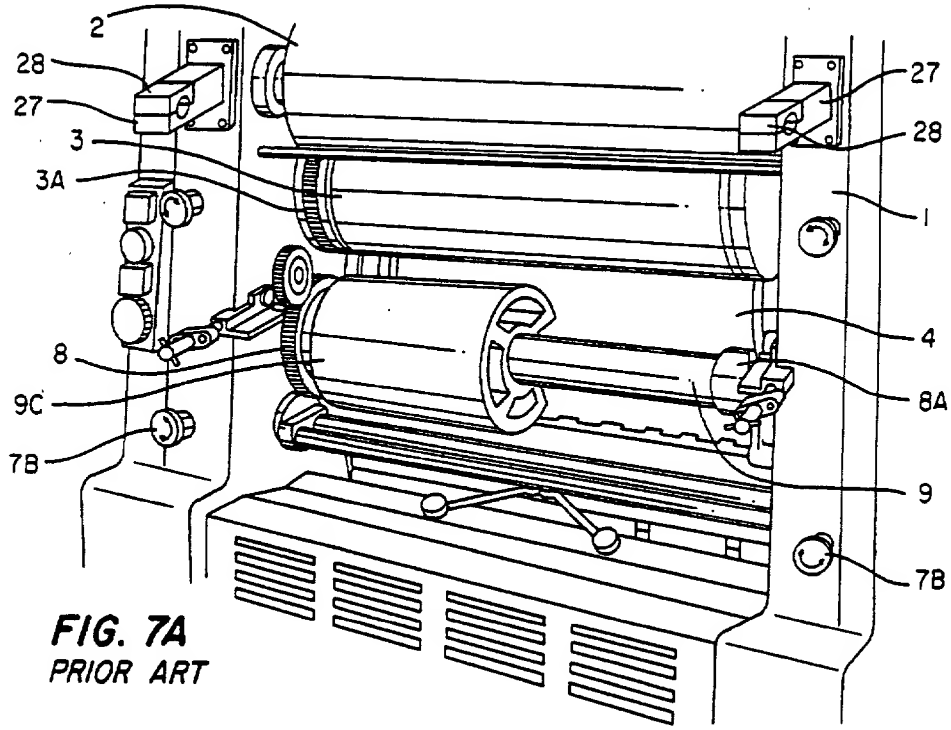

FIG. 7A
PRIOR ART

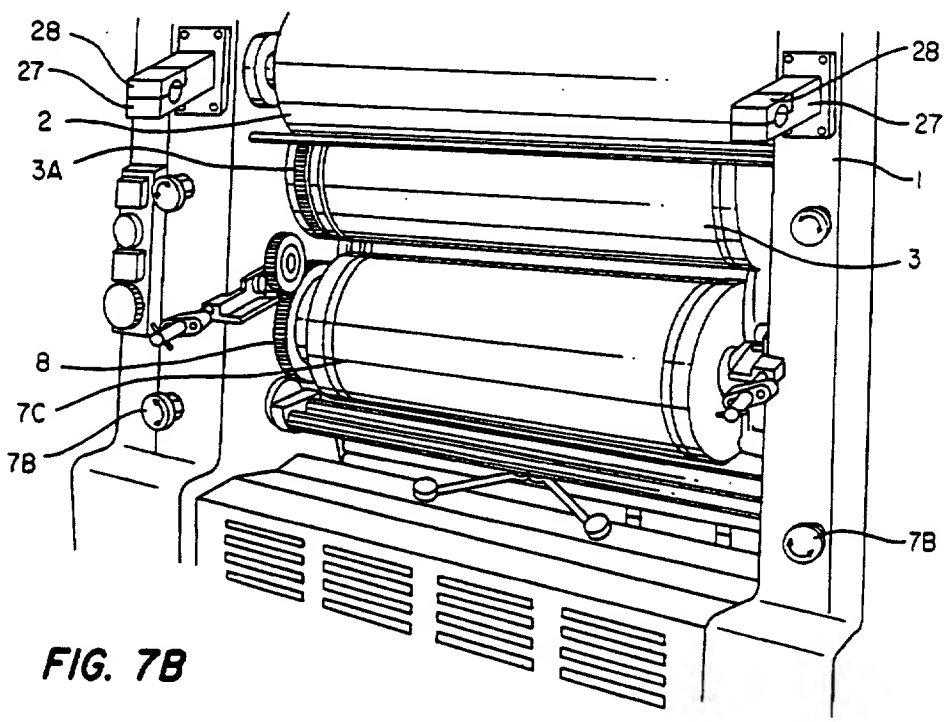

FIG. 7B

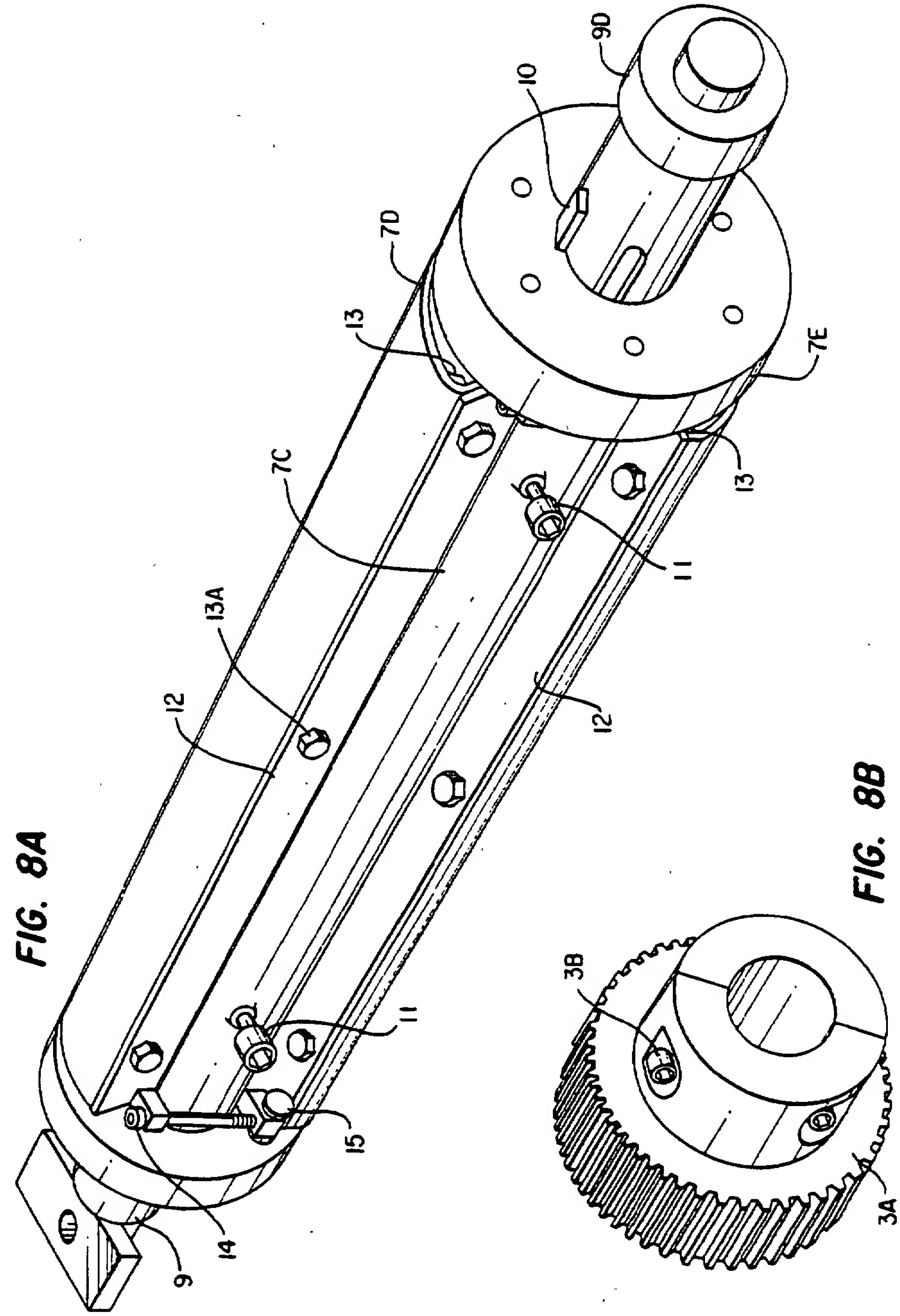

FIG. 8A

FIG. 8B

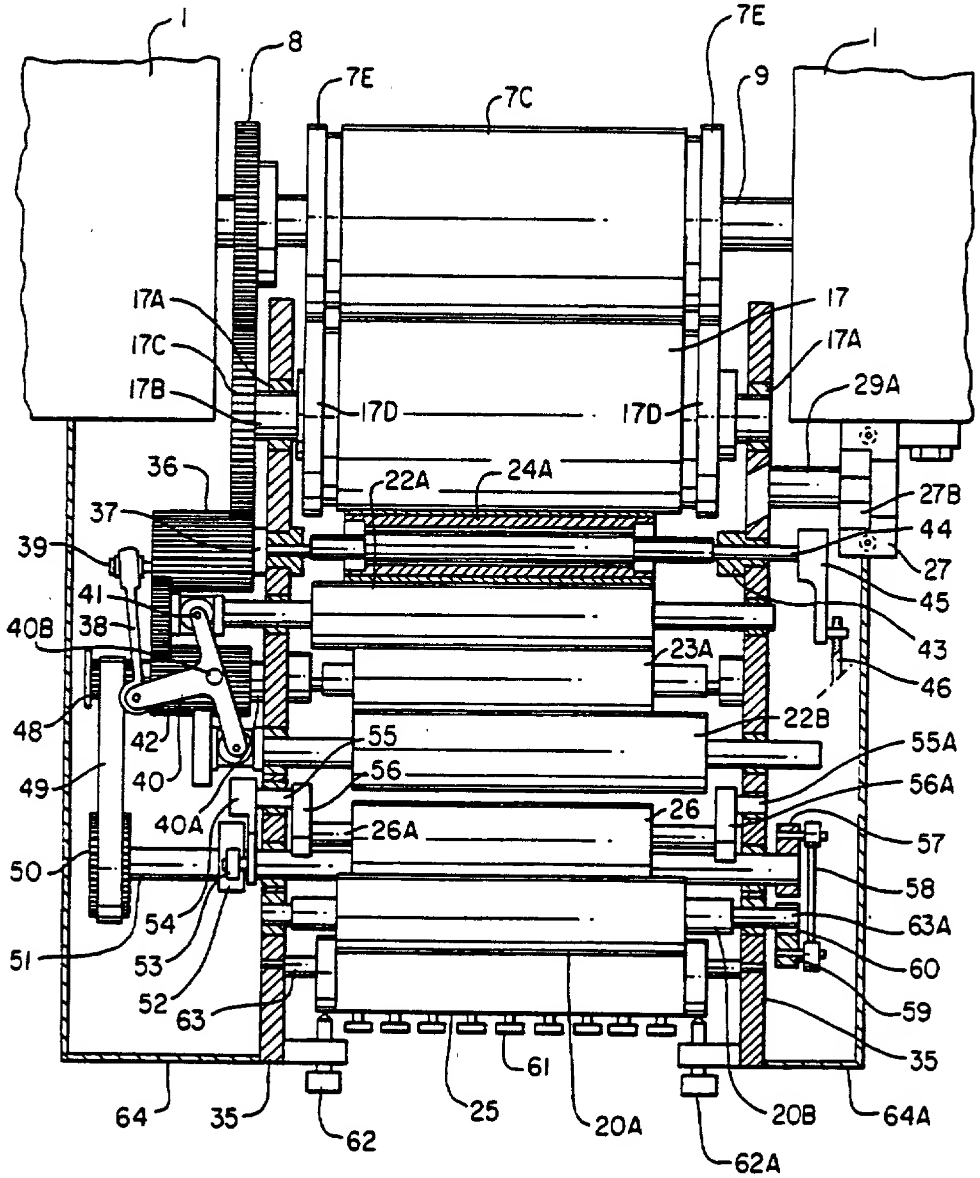

FIG. 9

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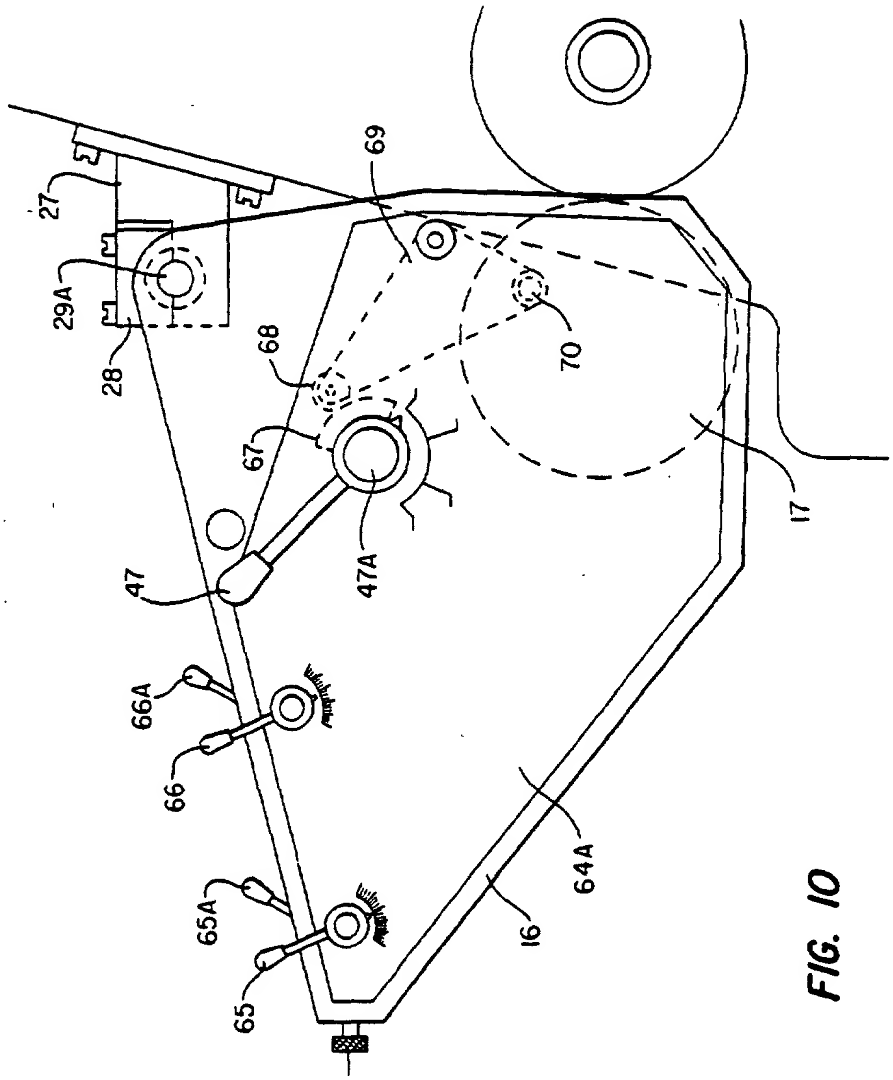

FIG. 10

REMOVABLE INKING DEVICE FOR OFFSET PRESS

FIELD OF THE INVENTION

The present invention relates to a detachable printing unit adapted to be fitted to existing offset printing presses or to be incorporated in such presses during their manufacture.

BACKGROUND OF THE INVENTION

This printing unit consists of an inking module and a blanket cylinder, which are independent of one another, in such a manner as to enable the inking module to be used alone or conjointly with the blanket cylinder.

In one form the invention is defined in that the numbering device with which the press is equipped is replaced by the blanket cylinder of the printing unit working with the inking module, and use is made of the drive mechanism and pressure adjustment mechanism provided in the press to obtain for each printing cycle, instead of the numbering, an additional color obtained by color superimposition.

In the other form of the invention the same inking module, disposed in another position in the press, works conjointly with the blanket cylinder of the press to enable for each printing cycle an additional color and optionally numbering to be achieved.

SUMMARY OF THE INVENTION

At the present time the great majority of professional offset printing presses are designed to print three or four colors. Their mode of operation differs little from one manufacturer to another, and the choice made by the printer is guided by the reliability of the presses, the simplicity of starting them up and operating them, and their production possibilities.

The operating principle of a traditional GTO Heidelberg press, which is representative of this type of machine and for that reason has been chosen to illustrate the invention, is descried schematically below by way of indication and with reference to the accompanying drawings.

The press shown in FIG. 1 consists of a frame 1 containing all the elements of which the press is composed. The inking unit 2A and its dampener 2B (inking rollers shown solid and dampening rollers hatched) moisten and ink the offset plate fixed on the plate cylinder 2. The inked plate prints its image on the blanket of the blanket cylinder 3. The paper 5 coming from the stack 5A is printed by transfer as it passes between the blanket cylinder 3 and the pressure cylinder 4. The printed sheet is taken up by the grippers of the chain delivery device 6, and is then deposited on the delivery stack 5B. The ink duct 2C and the system effecting dampening from the water reservoir 2D are provided with means enabling the supply of ink and water to be metered in dependence on the ink load necessary for the type of printing to be done. The plate cylinder 2 is provided with means for attaching and aligning the offset plate and with adjustment facilities for moving it circumferentially relative to the blanket cylinder 3, so as to achieve good positioning of the impression on the stock to be printed. The blanket cylinder 3 is also provided with the mechanical elements necessary for the fixing and tensioning of the blanket. The pressure cylinder 4 is

provided with grippers for holding the sheet during printing.

A detachable letterpress numbering and additional color device 7 (FIG. 2) is included in these presses and operates in the following manner:

The inking unit 7A inks the numberers 9B or the letterpress blocks, which deposit their impression directly on the sheet 5 which has just received its offset impression from the blanket of the blanket cylinder 3. This letterpress printing is effected in line in the same printing cycle as the offset printing and in perfect register with the latter, the drive means being synchronized and interconnected. The pressure necessary for this letterpress printing is obtained between the pressure cylinder 4 (as in offset printing) and the numberers or letterpress blocks. The adjustment screws 7B placed on each side of the press permit micrometer adjustment of the pressure of the shaft carrying the numberers or blocks. The chronological order determined for carrying out the different operations leading to the impression is arranged by various control levers designed for achieving this order. All these functions are synchronised for each printing cycle. These presses are provided with a very accurate sheet positioning mechanism enabling them to achieve perfect register of each color in the case of successive impressions on the same sheet. This type of professional presses is also made for two, four and five colors. These multicolor presses are formed by grouping together a number of basic one-color presses. The sheet passes in succession from one press to the other, use being made of mechanisms carrying it positively with the aid of grippers. In these presses the numbering device is disposed on the final printing press. Certain makers offer as an option an additional inking unit, usually detachable, for one offset color. These units are independent and are provided with all elements required for moistening and inking an offset plate fixed on a plate cylinder of the same diameter as that of the basic press, as well as the control mechanisms required for the chronological sequencing of all the functions. This inked plate prints its image on the blanket of the press, which consequently receives two inked images of different colors for each impression cycle. These two images are transferred simultaneously to the sheet passing between the blanket cylinder and the pressure cylinder of the press. These added units are in most cases not made by the large manufacturers of printing presses. One American manufacturer has specialized in this type of printing units adapted to be fitted to all kinds of presses, and many American and foreign printers use them successfully because these added units are very useful to printers, although they do not make it possible to obtain, in a positive manner, superimposed screen impressions without the risk of pollution by the intermixing of the inks, and to do this within a printing time the length of which varies with the amount of superimposed images to be inked.

This serious restriction, due to the principle of these added units, to a great extent limits their use and does not enable the printer to regard his press, equipped with this accessory, as a true two-color press.

The evolution of graphic style, of tastes and of printing techniques makes it necessary to produce multicolor prints inexpensively. For many printers not specializing in color printing the purchase of a two-color press is a problem, because the cost and size of such a press are twice those of a single-color press, thus making amortization difficult. This factor is all the more important in

the case of high quality presses for relatively small formats, of the GTO type, which for long runs of four-color printing find it difficult to compete with presses for double or quadruple format. In addition, a two-color press is poorly suited to one-color printing.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself however, as well as a preferred mode of use, further objects and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a simplified side view of a prior art Heidelberg press;

FIG. 2 is a simplified side view of a prior art Heidelberg press with a detachable letter press numbering unit attached thereto;

FIG. 3 is a simplified side view of a Heidelberg press of the present invention especially adapted according to the present invention with an auxiliary blanket cylinder and a detachable plate cylinder and inking module, which allows two color-printing with a single press run;

FIG. 4 depicts the improved press of the present invention with the detachable plate cylinder and inking module configured in an alternate mode of operation from that shown in FIG. 3 to allow the detachable plate cylinder to act upon the press blanket cylinder;

FIG. 5 is a view of the improved printing press of the present invention in a storage position;

FIG. 6A is a view of the prior art press from the delivery side of the blanket cylinder;

FIG. 6B is a view of the prior art press with the numbering cylinder of the detachable dual mode numbering and additional coloring device connected thereto, shown in a numbering configuration;

FIG. 7A is a view of the prior art press with the coloring cylinder of the detachable dual mode numbering and additional coloring device connected thereto, shown in an additional coloring configuration;

FIG. 7B is a view of the improved printing press of the present invention from the delivery side of the blanket cylinder with an auxiliary blanket cylinder coupled in place of the numbering/coloring cylinders;

FIG. 8A is a view of the auxiliary blanket cylinder of the present invention;

FIG. 8B is a view of a gear which is coupled to the prior art press to accommodate the operation of the auxiliary blanket cylinder and detachable module;

FIG. 9 is a partial sectional view of the detachable auxiliary plate cylinder and inking module of the present invention; and

FIG. 10 is a side view of the detachable auxiliary plate cylinder and inking module of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention seeks to improve the present state of the art by making it possible to produce compact offset presses offering increased facilities to the printer.

Within the scope of the invention the additional means provided for a traditional offset printing press can be defined generally as follows:

(a) a detachable inking module of traditional, known type whose inking power usually corresponds to that of the press and which has its own dampening unit, inking unit and plate cylinder, as well as all the mechanisms enabling the offset plate to be inked in chronological order.

(b) a detachable blanket cylinder mounted on the shaft of the numbering or additional color letterpress device of the press and replacing said device.

Starting with these two components of the printing unit, and depending on their arrangement on the press, the printer can at will, and within a short time, convert his single-color press either into a true two-color press offering the same possibilities and performance as a two-color press built on the basis of two presses, or into a single-color press plus an additional color and a numbering unit.

A third facility is offered in these presses provided with means for fitting these different components, namely the ability to mount another added unit on the press converted into a true two-color press.

If the press which is to be equipped with an additional printing unit is not provided with a numbering device, a device of this kind can be added and its drive shaft will be used in the same manner as with a press originally equipped to support and drive the blanket cylinder.

In addition to the fitting of the additional units to existing presses, the construction of presses directly fitted during their production with the same detachable modular components, without departing from the scope of the present invention, is also desirable, because this makes it possible to produce, at lower cost, two-color machines which can equally well print one or two colors or twice two colors and which are much more compact and easy to use, while offering not negligible additional facilities. It is quite obvious that the printing unit may allow wide variations in its inking or dampening methods or may effect waterless offset printing, without departing from the scope of the invention.

These different possibilities are of great interest to the printer, because in the case of color superimposition printing there is rarely a need for numbering, whereas numbering jobs often require an additional color.

FIG. 3 shows the printing unit in which the detachable inking module 16 works with its blanket cylinder 7C to provide an additional color by color superimposition in conjunction with the color of the press. This blanket cylinder 7C is mounted direct on the same shaft 9 which carries the rings 9A (FIG. 2) carrying numbers 9B. The drive is provided by the gear 8 (FIG. 9), which serves to operate the letterpress inking and additional printing unit 7A (FIG. 2) used for numbering.

The plate cylinder 17 (FIG. 3) is provided with all the usual devices for the tensioning and alignment of the plate, as well as for circumferential and axial adjustment to allow good positioning of the printing on the sheet. The dampening unit 18 transfers the moistening liquid from its reservoir 19 to the plate cylinder 17 with the aid of the conventional system comprising the water ductor 20, feed roller 21, sliding table 22, moistening roller 23, and plate moistening rollers 24. The ink contained in the duct 25 is fed and and ground as far as the plate inking rollers 24A inking the offset plate with the aid of the duct rollers 26, distribution rollers 23A, and grinding cylinder 22A. The sheet of paper 5 taken from the stack 5A is pressed in succession by the pressure cylinder 4 first against the blanket cylinder 3 normally installed on the press and printing the first color, and then secondly against the blanket cylinder 7C, which prints the second color. The sheet 5, having received the inks of two

colors, is taken over by the grippers of the chain delivery device 6 and deposited on the delivery stack 5B.

The inking module 16 is supported by two bearings 27, whose detachable caps 28 (FIG. 5) hold the shafts 29A (FIG. 9) in position, thus enabling the inking module 16 to follow the slight movements of the shaft 9 (FIG. 3) of the additional blanket cylinder 7C for the application of pressure when the press is printing and for the relaxing of pressure when it is stopped. The ability to remove quickly the caps 28 (FIG. 5) of the bearings 27 makes it possible to change over very quickly from the arrangement shown in FIG. 3, using the additional blanket cylinder 7C fastened to the shaft 9 provided for carrying the numberers, to the arrangement shown in FIG. 4 in which the plate cylinder 17 of the inking module 16 is used to apply the ink of the second color to the blanket of the blanket cylinder 3, the ink of the first color having already been applied to it by the plate cylinder 2 of the press. In this arrangement the numbering and additional letterpress color system is normally used.

FIG. 5 shows the inking module 16 in the stored position, out of use.

For greater ease and greater accuracy in the movement and positioning of the inking module 16, manipulation is assisted by a mechanism which retracts during printing and which works in the following manner. Pneumatic struts 29 bear against the frame 1 of the press, and lifting arms pivoted on the bearings 31 fixed on the frame 1 of the press raise the inking module 16 by means of connecting rods 32 pivoted on the arms 30 by the pins 33 and on the inking module 16 by the pins 34. An eccentric shaft 31A operated by a lever 31B enables the device to be deposited on the top of the printing press frame in the position of rest.

The invention, as characterized in the claims, is described below in detail with the aid of the drawings accompanying the text and illustrating one of the preferred embodiments in its different printing versions and fitted to a GTO Heidelberg press.

FIG. 6, View A, is a front view on the press delivery side of the blanket cylinder 3 on which is fixed and adjusted a gear 3A enabling the inking module 16 (FIG. 3) to be driven in the position for printing two superimposed colors. The gear 8 (FIG. 6) serves as a power take-off driving the shaft 9 serving as rotating support either for the disks 9A (FIG. 6, View B) on which the numberers 9B are fixed, or for the sleeve 9C (FIG. 7, view A) to which the letterpress blocks are secured by adhesive bonding, or else for the performance of the invention for the blanket cylinder 7C (FIG. 7, View B) on which the plate cylinder 17 (FIG. 3) of the inking module 16 will deposit ink from its plate representing the image to be printed. The micrometer screws 7B (FIG. 2) for pressure adjustment, which are provided for letterpress printing, serve the same function for offset printing. The bearings 27 and 27A and their caps 28 and 28A enable the inking module 16 (FIG. 3) to be supported and positioned on the press in its two operating positions. The ring 8A (FIG. 6, View A) positions and serves as support for the bearing 9D (FIG. 8, View A) of the movable support shaft 9 (FIG. 6, View B). The device for the automatic release of pressure in the event of no sheet being fed also operates for two-color offset printing.

FIG. 6, View B, shows the same section of the press as View A, and in addition shows the rotating support shaft 9 connected to the power take-off gear 8 and the ring 8A serving to support it, said shaft turning in phase with the machine and carrying, mounted on it before it is fitted, the disks 9A and the numberers 9B.

FIG. 7, View A, shows, for the sake of good understanding of the invention, the same section in which the disks 9A (FIG. 6, View B) carrying the numberers 9B have been replaced by the sleeve 9C (FIG. 7, View A), on which are fixed the letterpress blocks and which is mounted on the same rotating support shaft 9.

FIG. 7, View B, shows the same section, in which the sleeve 9C (FIG. 7, View A) has been replaced with the blanket cylinder 7C, provided with its impression blanket 7D and mounted on the rotary support shaft 9 driven by the gear 8.

FIG. 8, View A, shows a construction of the blanket cylinder 7C mounted on the rotating shaft 9 driving it. The rotating shaft 9 drives the blanket cylinder 7C directly, said cylinder being prevented from turning on said shaft by the key 10 and from making translatory movements by the stop screws 11. The blanket 7D is gripped between the tensioning bars 12 and the clamp bars 13 held by the screws 13A. The tightening of the spherical head screws 14 effects the normal tensioning of the blanket 7D by being screwed into the cylindrical nuts 15, which brings about the rocking of the tensioning bars 12 on the blanket cylinder 7C.

FIG. 8, View B, shows the gear 3A permanently positioned on the shaft of the blanket cylinder 3 (FIG. 6). In cases where the inking unit is fitted to existing presses, this gear is made in two halves in order to enable it to be installed without having to dismantle the printing press. It is machined with extreme precision in order to ensure perfect rotation of the gear teeth, without eccentricity or wobble. The screws 3B hold the two gear halves together, and at the same time ensure clamping on the blanket cylinder shaft by a pinching action.

FIG. 9 shows a partial section of the inking module 16, illustrating the general principles applied for depositing the ink on the blanket cylinder 7C. The plates 35 supporting the components of the inking module 16 are attached to the printing press by means of shafts *29a* pivoting in the supports 27 with the aid of ball bearings 27B. The plate cylinder 17 turning in its bearings 17A carries at one end of its shaft 17B the gear 17C keyed on it and driven rotationally by the drive gear 3C of the printing press. The gear 36 turning on its stationary shaft 37 operates the connecting rod 38 by means of the eccentric crankpin 39 mounted on a ball joint. The connecting rod 38 in turn moves the lever 40 which is pivoted on the support 40A by means of the pin 40B and whose rollers 41 alternately push to the right, and then to the left, the sliding tables 22A and 22B serving to grind the ink. These tables are driven rotationally by the gear 36 and the gear 42, the number of teeth of which enables them to obtain the same circumferential speed as the plate cylinder 17, the ink transfer rollers 23A and plate inking rollers 24A thus being driven by simple contact with light pressure. This pressure is adjusted by the combined rotations of the eccentric bearings 43 acting on the pressure against the sliding table 22A, and of the eccentric shaft 44 of the plate inking rollers 24A acting on the pressure against the plate on the plate cylinder 17. One end of the eccentric shaft 44 carries a crank 45 connected by a connecting rod 46 to the single control lever 47 (FIG. 10). Each plate inking roller 24A (FIG. 3) and plate moistening roller 24 is connected in the same manner to the single control lever 47 (FIG.

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10). Depending on the position of the latter, it is possible to bring the assembly of plate inking rollers 24A or the assembly of plate moistening rollers 24 into or out of contact with the plate on the plate cylinder 17 (FIG. 3). The gear 42 (FIG. 9) carries at one end a cogged pulley 48 which with the aid of a cogged belt 49 turns the cogged pulley 50 keyed on the shaft 51 with a reduction ratio such that the shaft 51 makes one rotation for every format printed. The cam 52 keyed on the shaft 51 thus raises the cam roller 53 fixed at the end of the lever 54 for each impression cycle. The lever 54 is keyed to one end of the shaft 55, to the other end of which is keyed the lever 56, which thus permits the to-and-fro movement of the ink feed roller 26 turning on the shaft 26a fixed at one end on the lever 56 and at the other end on the lever 56A pivoted on the shaft 55A. In the forward movement the ink feed roller 26, bearing against the ink ductor 20A of the duct 25, becomes coated with ink, which it deposits on the sliding table 22B at the end of the return movement. The rotating shaft 51 carries at one end the crank 57, on which pivots the connecting rod 58 fixed to the lever 59. This lever is mounted pivotally on the shaft 20B of the ink ductor roller 20A with the aid of the free wheel 60. In its oscillation, the movement of the lever 59 thus turns the ink ductor roller 20A a few degrees in the same direction with the aid of the free wheel 60, which roller is thus coated in the ink reservoir 25, the flow from which is ensured by adjustment screws 61. Screws 62 and 62A keep the ink reservoir 25 closed, although it can be opened for washing by turning it about pins 63 and 63A. It should be noted that the kinematics of the moistening liquid distribution system is in general arranged in the same manner as the kinematics of the ink distribution system. Protective casings 64 and 64a prevent direct access to the mechanical systems, which could be dangerous to the user.

FIG. 10 shows the inking module 16 on which all the controls necessary for the correct use of the module are disposed. The lever 65, with index and graduated scale, regulates the amplitude of the rotary movement of the ink ductor roller 20A (FIG. 9) by acting on the pawl of he free wheel 60. The lever 65A (FIG. 10) enables the ink ductor roller 20A (FIG. 9) to be turned by hand. The screws 61 regulate the coating of the ink ductor roller 20A, thus acting, conjointly with the selection of the position of the lever 65 (FIG. 10), on the amount of ink deposited on the plate on the plate cylinder 17. The lever 66, which is also provided with an index and graduated scale, regulates the amplitude of the rotation of the moistening liquid ductor roller 20 (FIG. 3), thus acting directly on the flow of liquid deposited on the plate on the plate cylinder 17. The lever 66A enables the moistening liquid ductor roller 20 (FIG. 3) to be turned by hand. Judicious adjustment of the screws 61 (FIG. 10) and of the levers 65 and 66 thus makes it possible to deposit on the plate on the plate cylinder 17 the amount of ink and moistening liquid most suitable for an excellent impression. The single four-position control lever 47 selects the different functions. In the "stop" position the connecting rods 46 (FIG. 9), which are not completely shown for the sake of clarity in the drawing and which are controlled directly by the single control lever 47 (FIG. 10), push the levers 45 (FIG. 9) into a position such that the eccentric shafts 44 move the moistening rollers 24 (FIG. 3) and inking rollers 24A away from the plate cylinder 17. In the "moisten" position of the single control lever 47 (FIG. 10) only the connecting rods 46 (FIG. 9) controlling the plate moistening rollers 24 (FIG. 3) are operated, thus bringing these rollers to bear against the plate on the plate cylinder 17 in order to effect the necessary moistening of said plate. In the "inking" position, the plate inking rollers 24A are in turn brought to bear against the plate on the plate cylinder 17. It should be observed that these operations are carried out without the plate cylinder 17 (FIG. 10) coming into contact with the blanket cylinder 7C. A cam is in fact keyed on the shaft 47A of the single control lever 47 to act on the roller 68 of the lever 69 pivoted by the pin 70 on a plate 35 of the inking module 16. The lever 69 bears directly against the frame 1 of the printing press to pivot the inking module 16 on its pivot pins 29A. In the "print" position the single control lever 47 turns the cam 67, the depression on which causes the lever 69 to pivot and the inking module 16 to rock in such a manner that the running tracks 17D (FIG. 9), known as bearers, of the plate cylinder 17 come to bear against the bearers 7E of the blanket cylinder 7C. The pressure is applied between plate and blanket, thus enabling ink to be transferred from the plate on the plate cylinder 17 to the blanket on the blanket cylinder 7C. The impression can now be made by pressing the sheet 6 (FIG. 3) between the pressure cylinder 4 and the blanket cylinder 7C.

Within the scope of the invention presses of larger formats can be equipped in the same way by employing the same means which characterize the invention in its claims taken as a whole.

I claim:

1. In a printing press having:

a plate cylinder;

a means for linking said plate cylinder in a first color with a first ink;

a blanket cylinder in circumferential contact with said plate cylinder for receiving images from said plate cylinder in said first ink;

a pressure cylinder in adjustable circumferential contact with said blanket cylinder;

a feed means for drawing paper between said pressure cylinder and said blanket cylinder to deposit said images in said first ink on said paper;

a drive means for rotating said plate cylinder, blanket cylinder, and said pressure cylinder;

a detachable dual mode numbering and coloring device including a inking unit in circumferential contact with a removable numbering cylinder, said removable numbering cylinder being in circumferential contact with said pressure cylinder and rotated by said drive means, for printing page numbers on said paper drawn between said removable numbering cylinder and said pressure cylinder when in a numbering mode, and with said inking unit in circumferential contact with a removable coloring cylinder, said removable coloring cylinder being in circumferential contact with said pressure cylinder and rotated by said drive means, for printing images in a second ink of a second color on said paper drawn between said removable coloring cylinder and said pressure cylinder when in a coloring mode;

the improvement comprising:

a removable auxiliary blanket cylinder adapted for attachment in the press in the location provided for the removable numbering and coloring cylinders, and for rotation by said drive means; and

a movable inking module coupled to said printing press, including an inking unit, a damping unit, and

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an auxiliary plate cylinder, operable in a first mode with said auxiliary plate cylinder in circumferential contact with said auxiliary blanket cylinder for depositing images in a third ink of a third color on said paper, and operable in a second mode with said auxiliary plate cylinder in circumferential contact with said blanket cylinder for depositing images in a third ink of a third color on said paper while allowing simultaneous operation of said detachable dual mode numbering and color device.

2. A printing press according to claim 2, wherein the said movable inking module is suspended along said press by a pivoting arm.

3. A printing press according to claim 2, wherein said movable inking module is suspended along said press by a pivoting arm and configurable in three positions relative to said press, including a first position with said auxiliary plate cylinder in circumferential contact with said auxiliary blanket cylinder in said first mode of operation, a second position with said auxiliary plate cylinder in circumferential contact with said blanket cylinder in said second mode of operation, and a third position with said movable inking module placed in a storage position.

4. A printing press comprising in combination:

a plate cylinder;

a means for inking said plate cylinder in a first color with a first ink;

a blanket cylinder in circumferential contact with said plate cylinder for receiving images from said plate cylinder in said first ink;

a pressure cylinder in adjustable circumferential contact with said blanket cylinder;

a feed means for drawing paper between said pressure cylinder and said blanket cylinder to deposit said images in said first ink on said paper;

a drive means for rotating said plate cylinder, blanket cylinder, and said pressure cylinder;

a removable auxiliary blanket cylinder adapted for attachment in the press adjacent said pressure cylinder and rotatably by said drive means;

a movable inking module coupled to said printing press, including an inking unit, a damping unit, and an auxiliary plate cylinder, operable in a first mode with said auxiliary plate cylinder in circumferential contact with said auxiliary blanket cylinder for depositing images in a second ink of a second color on said paper, and operable in a second mode with said auxiliary plate cylinder in circumferential contact with said blanket cylinder for depositing images in a second ink of a second color on said paper.

5. A printing press according to claim 4, wherein movable inking module is suspended along said press by a pivoting arm.

6. A printing press according to claim 5, wherein said movable inking module is suspended along said press by a pivoting arm and configurable in three positions relative to said press, including a first position with said auxiliary plate cylinder in circumferential contact with said auxiliary blanket cylinder in said first mode of operation, a second position with said auxiliary plate cylinder in circumferential contact with said blanket cylinder in said second mode of operation, and a third position with said movable inking module placed in a storage position.

* * * * *

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United States Patent [19]

Bird

[11] **Patent Number: 4,895,070**

[45] **Date of Patent: Jan. 23, 1990**

[54] **LIQUID TRANSFER ASSEMBLY AND METHOD**

[75] Inventor: John W. Bird, Westport, Conn.

[73] Assignee: Birow, Incorporated, Westport, Conn.

[21] Appl. No.: 217,412

[22] Filed: Jul. 11, 1988

[51] Int. Cl.[4] B41L 23/00

[52] U.S. Cl. 101/148; 101/216; 101/349; 101/367; 118/46

[58] Field of Search 101/348, 349, 147, 148, 101/350, 152, 153, 174, 216, 367; 118/46

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Primary Examiner—Eugene H. Eickholt
Attorney, Agent, or Firm—Perman & Green

[57] **ABSTRACT**

A liquid transfer assembly is shown which transfers a predetermined thickness of liquid to a moving surface, the assembly employing a shearing action to achieve the predetermined thickness. The system includes a supply means for providing a source of the liquid; a first arcuately shaped surface which moves at a first speed and is adapted to contact the supply means so as to obtain a coating of liquid on its surface. A second surface is juxtaposed to the first surface but not in contact therewith, moves at a second speed different from the first speed; and the distance between the two surfaces is sufficiently close that the liquid on the first surface comes in contact with the second surface at their nearest point of proximity. Thus, by virtue of the different surface velocities, the liquid is subjected to a shearing action at the nearest point of proximity with a determined amount thereof being transferred to the second surface.

4 Claims, 1 Drawing Sheet

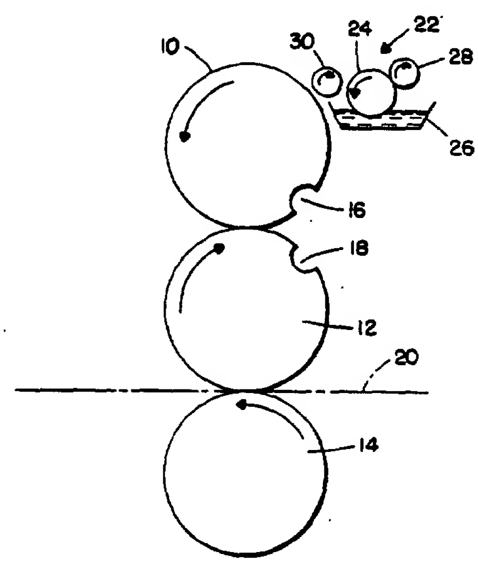

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FIG. 1.

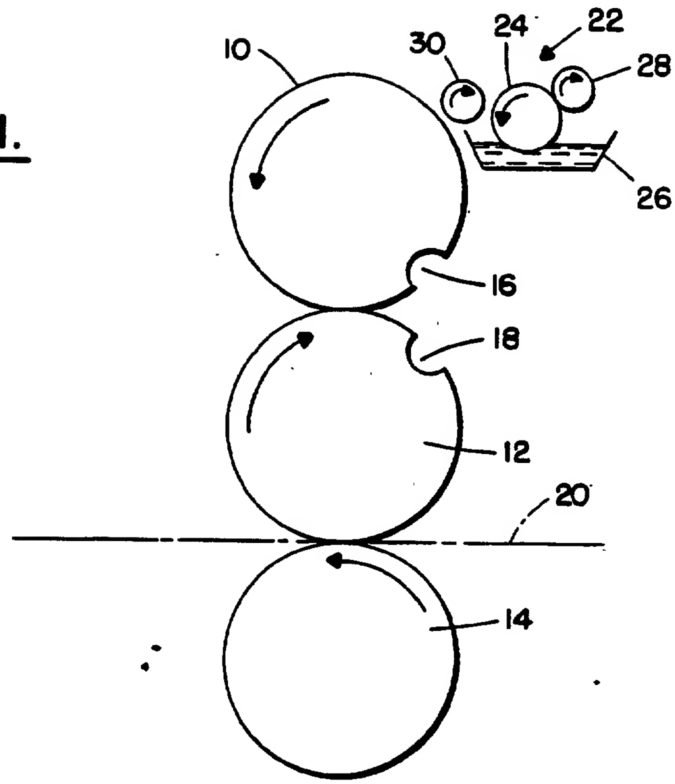
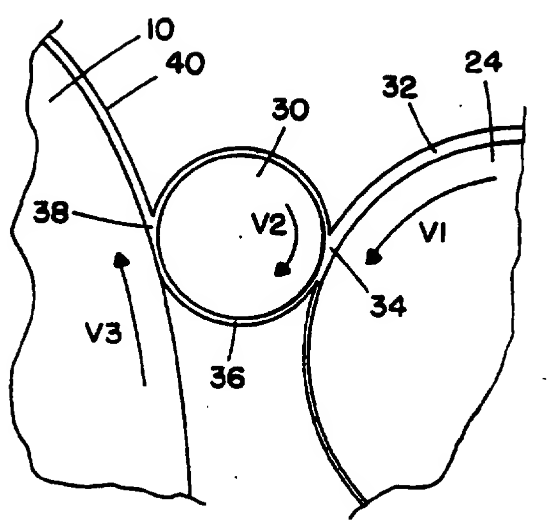


FIG. 2.



LIQUID TRANSFER ASSEMBLY AND METHOD

FIELD OF THE INVENTION

This invention relates to offset lithographic printing and more particularly to a means and method for transferring liquid from a reservoir to an offset lithographic plate cylinder.

BACKGROUND OF THE INVENTION

In offset lithographic printing, each printing stage includes a plate cylinder, to which printing plates are tightly fastened around its circumference. The plate cylinder is equipped with inking and dampening mechanisms. The plate includes both image and non-image areas which are substantially coplanar, the image portions being hydrophobic and the non-image areas being hydrophilic. The dampening system applies an aqueous solution to the non-image areas and the inking system applies a greasy ink to the image areas. The plate cylinder transfers its image to an intermediate blanket cylinder which has a specially composed smooth rubber blanket surface. Printing stock in either sheet or webbed form is fed against the blanket cylinder by an impression cylinder and the ink (and dampening solution), is transferred to the printing stock thus completing the printing operation.

In applicator roll assemblies used with conventional lithographic printing cylinders, a pick-up roll is partially immersed in a trough containing a continuous supply of liquid. The liquid may be water, ink or a coating composition. The surface of the pick-up roll "picks up" a relatively thick coating of the liquid and rotates it into contact with a metering roll which controls or meters the thickness of the coating which is to remain on the surface of the pick-up roll. Excess liquid is returned to the trough. Further rotation of the pick-up roll brings it into pressure contact with an applicator roll whereby the applicator roll obtains a coating of the liquid from the pick-up roll. Finally, the applicator roll rotates into pressure contact with the plate cylinder (or in some instances the blanket cylinder) which is coated with the liquid by the pressure/rolling action of the applicator roll.

As the applicator roll moves about the outer periphery of the plate cylinder, it comes into contact with a plate clamp aperture where plates are secured to the outer periphery of the plate cylinder. Unless the applicator roll/plate cylinder contact pressure is very closely controlled, the clamp aperture will often cause the applicator role to slightly move away from the periphery of the plate cylinder as the plate clamp aperture passes beneath it. This can create an interruption in the application of the liquid to the plate with resulting nonuniformities in the printed product.

Accordingly, it is an object of this invention to provide an improved liquid transfer assembly for offset lithographic printing apparatus.

It is another object of this invention to provide an improved liquid transfer assembly for offset lithographic printing apparatus wherein uniform layers of applied liquid result from the action of the transfer assembly.

SUMMARY OF THE INVENTION

A liquid transfer assembly is shown which transfers a predetermined thickness of liquid to a moving surface, the assembly employing a shearing action to achieve the predetermined thickness. The system includes a supply means for providing a source of the liquid; a first arcuately shaped surface which moves at a first speed and is adapted to contact the supply means so as to obtain a coating of liquid on its surface. A second surface is juxtaposed to the first surface but not in contact therewith; moves at a second speed different from the first speed; and the distance between the two surfaces is sufficiently close that the liquid on the first surface comes in contact with the second surface at their nearest point of proximity. Thus, by virtue of the different surface velocities, the liquid is subjected to a shearing action at the point of proximity with a determined amount thereof being transferred to the second surface.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side, schematic view of an offset lithographic printing apparatus showing the relationship of the liquid transfer assembly thereto.

FIG. 2 is an expanded view of the contact surfaces of liquid transfer assembly.

DETAILED DESCRIPTION OF THE INVENTION

Reference is made to the following copending applications, all of which describe further details of an offset lithographic printing apparatus useful in conjunction with the invention hereof. The disclosure of each is incorporated herein expressly by reference: U.S. patent application, Ser. No. 65,914 filed June 24, 1987 and entitled "Coating and Printing Method and Apparatus Including An Interstation Dryer"; and U.S. Pat. No. 4,796,556 entitled "Adjustable Coating and Print Apparatus"; all to John W. Bird.

Referring now to FIG. 1, plate cylinder 10, blanket cylinder 12 and impression cylinder 14 are all of the conventional variety normally found in offset lithographic printing machines. Plate cylinder 10 is provided with a plate clamp aperture 16 wherein the print plate (not shown) is clamped to the external circumference of plate cylinder 10. In a similar manner, blanket cylinder 12 is provided with a blanket clamp aperture 18 where the blanket is secured. As is well known, a continuous conveyer belt, schematically shown at 20, feeds sheets to be imprinted between blanket cylinder 12 and impression cylinder 14.

A dampening system 22 includes a pick-up roll 24 which has a part of its circumference immersed in liquid bath 26 (e.g. water). A metering roll 28 is positioned to co-act with pick-up roll 24 to remove excess and otherwise assure a continuous film of liquid on pick-up roll 24. An applicator roll 30 is positioned so as to be close to, but not in contact with pick-up roll 24 as well as the outer surface of plate cylinder 10. In this preferred embodiment, pick-up roll 24, metering roll 28 and applicator roll 30 are each individually driven by separate motors so as to enable the speed of each to be individually adjusted. While not shown, additional coating stations for the purpose of applying inking solutions or coating solutions may also be emplaced about the periphery of plate cylinder 10 in the normal manner. It is here emphasized that the liquid transfer principle to be hereinafter discussed with respect to the dampening system, applies, in substance, to other coating application stations.

Referring now to FIG. 2 in conjunction with FIG. 1, an expanded view of applicator roll 30 is shown in con-

junction with portions of plate cylinder 10 and pick-up roll 24. After the surface of pick-up roll 24 leaves the vicinity of metering roll 28, a layer of liquid 32 (e.g. water) resides on its surface. The peripheral velocity of pick-up roll 24 is adjusted so that it exhibits a characteristically constant velocity V1. The distance between the surfaces of applicator role 30 and pick-up roll 24, at their nearest point of proximity 34, is adjusted so that the surface of applicator role 30 comes into contact with liquid layer 32 as it passes therebetween. Velocity V2 of applicator role 30 is adjusted to be greater than V1 so as to create, at proximity point 34, a shearing action on liquid 32. This shearing action causes a layer of liquid 36 to adhere to the outer periphery of applicator role 30 and to be carried around its periphery until it comes into contact at proximity point 38 with the external periphery of plate cylinder 10. Here again, the velocity V3 of plate cylinder 10 is adjusted to be higher than V2 so that a further shearing action occurs on liquid layer 36 as it reaches point 38. The shearing action results in a layer of liquid 40 being applied to plate cylinder 10.

By adjusting the relative velocities of the rolls/cylinder surfaces, the thicknesses of liquid layers 36 and 38 can be readily adjusted (assuming identical wetting characteristics of the moving surfaces). More specifically, as the velocity V2 is increased with respect to V1, a thicker layer of liquid 36 adheres to the surface of applicator role 30. In similar fashion, as the velocity V3 of plate cylinder 10 is increased with respect the velocity V2 of applicator roll 30, the thickness of liquid layer 40 can be made to increase. Conversely, as peripheral velocities V2 and V3 approach each other, the layer 40 of liquid adhering to plate cylinder 10 will decrease in thickness. However, if the peripheral velocities become equal or so close as to negate a shearing action, the liquid layer thicknesses will split and tend to become non-uniform.

The above stated, non-contacting liquid application system provides a number of advantages. One is that there is no contact between applicator role 30 and plate cylinder 10 thereby preventing any contact between applicator role 30 and plate clamp aperture 16. Another is that the amount of wear on the respective rolls/cylinder is greatly decreased. The system further provides for relatively easy adjustment of the amounts of liquid to be applied to plate cylinder 10. As aforestated, it is important that the peripheral velocities of adjoining rolls/cylinder be somewhat different to sustain the shearing action which creates the desired thickness of liquid coating.

The motive power for each of the rolls and cylinders should be linearly adjustable in speed so as to provide the desired variability of circumferential velocities. Hydraulic motors are preferred; however electric motors of the variable speed variety are also acceptable.

The above described liquid transfer assembly is particularly adapted to application as a dampening system for a plate cylinder. This is due to the fact that the viscosity of water is relatively constant (notwithstanding temperature changes) and enables the dampening system, once adjusted, to operate properly for long periods of time. On the other hand, if the viscosity of the liquid is subject to large changes or is highly viscous, this invention is less well suited. It is applicable to inking systems where ink of relatively medium to low viscosities are employed and to coating applications where relatively constant viscosity coating materials are utilized.

This invention further reduces the maintenance necessary for offset printing apparatus and substantially negates the need for chilling of the dampening solution. As is well known, especially for web presses, roll pressures generate substantial heat and cause the dampening solution to increase in temperature—thereby requiring refrigeration. This invention decreases the resulting roll-generated heat and this reduces refrigeration requirements.

It is to be understood that the above described embodiment of the invention is illustrative only and that modifications throughout may occur to those skilled in the art. Accordingly, this invention is not to be regarded as limited to the embodiment disclosed herein but is to be limited as defined by the appended claims.

I claim:

1. In an assembly for transferring a predetermined thickness of liquid to a moving surface, said liquid exhibiting a relatively constant velocity over the operating conditions experienced by said assembly, the combination comprising:

supply means for producing a source of said liquid:

a liquid bearing applicator roll movable at a first speed and adapted to contact said supply means and obtain a coating of said liquid on said surface;

a plate cylinder juxtaposed to said applicator roll and adapted to be moved at a second speed different from said first speed, said plate cylinder being maintained out of contact with said applicator roll but sufficiently close thereto that said liquid coating on said applicator roll comes in contact with said plate cylinder at the nearest point of proximity of said roll and cylinder, whereby said liquid coating is subjected to a shearing action at said nearest point of proximity with a determined amount thereof being transferred to said plate cylinder by shearing action.

2. The invention as recited in claim 1 wherein said liquid is water.

3. The invention as recited in claim 1 wherein said liquid is ink.

4. The invention as recited in claim 1 wherein said liquid is a coating material.

* * * * *

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United States Patent [19]

Tyler

[11] **Patent Number: 4,919,048**

[45] **Date of Patent: * Apr. 24, 1990**

[54] **APPARATUS FOR PREVENTING CONTACT OF WET INK SHEETS WITH PRINTING PRESS DELIVERY MECHANISMS AND FOR DRYING SAID WET INK**

[76] Inventor: **Jack D. Tyler**, 3017 Morton, Fort Worth, Tex. 76107

[*] Notice: The portion of the term of this patent subsequent to Feb. 2, 2005 has been disclaimed.

[21] Appl. No.: **145,286**

[22] Filed: **Jan. 19, 1988**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 891,955, Aug. 1, 1986, Pat. No. 4,722,276.

[51] **Int. Cl.**[5] **B41F 21/08**; B41F 5/22; B41L 21/10

[52] **U.S. Cl.** **101/217**; 101/232; 101/420

[58] **Field of Search** 101/232, 217, 424.1, 101/420, 419, 408, 409, 246; 271/195

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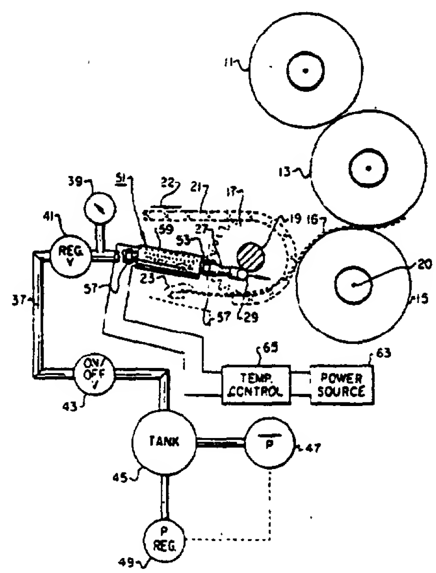
Primary Examiner—J. Reed Fisher

Attorney, Agent, or Firm—James E. Bradley

[57] **ABSTRACT**

A printing press has an apparatus for preventing contact of wet ink sheets with the chain delivery mechanism and for drying the wet ink carried on the sheets prior to the stacking of the sheets. The printing press has an impression cylinder and a blanket cylinder through which sheets are drawn by the chain delivery mechanism. The chain delivery mechanism has two sprockets mounted to a shaft, each of which rotates runs of chain to pull the sheets from the cylinders. A nozzle is mounted adjacent the shaft for discharging jets of air against the sheets to push them away from the shaft. An air compressor supplies air to the nozzle. A heating element is disposed between the air compressor and the openings of the nozzle to heat the pressurized air stream to a selected temperature sufficient to dry the wet ink carried by the sheets.

8 Claims, 2 Drawing Sheets



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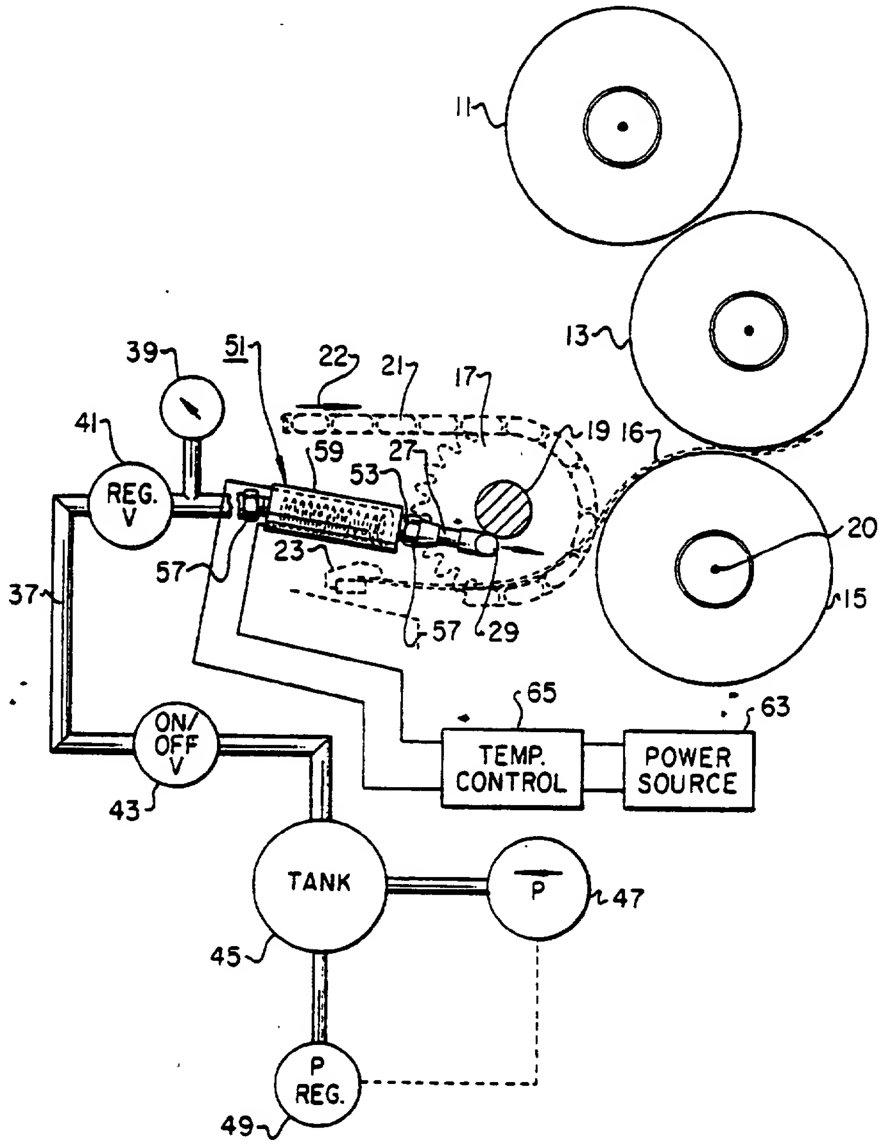

Fig. 1

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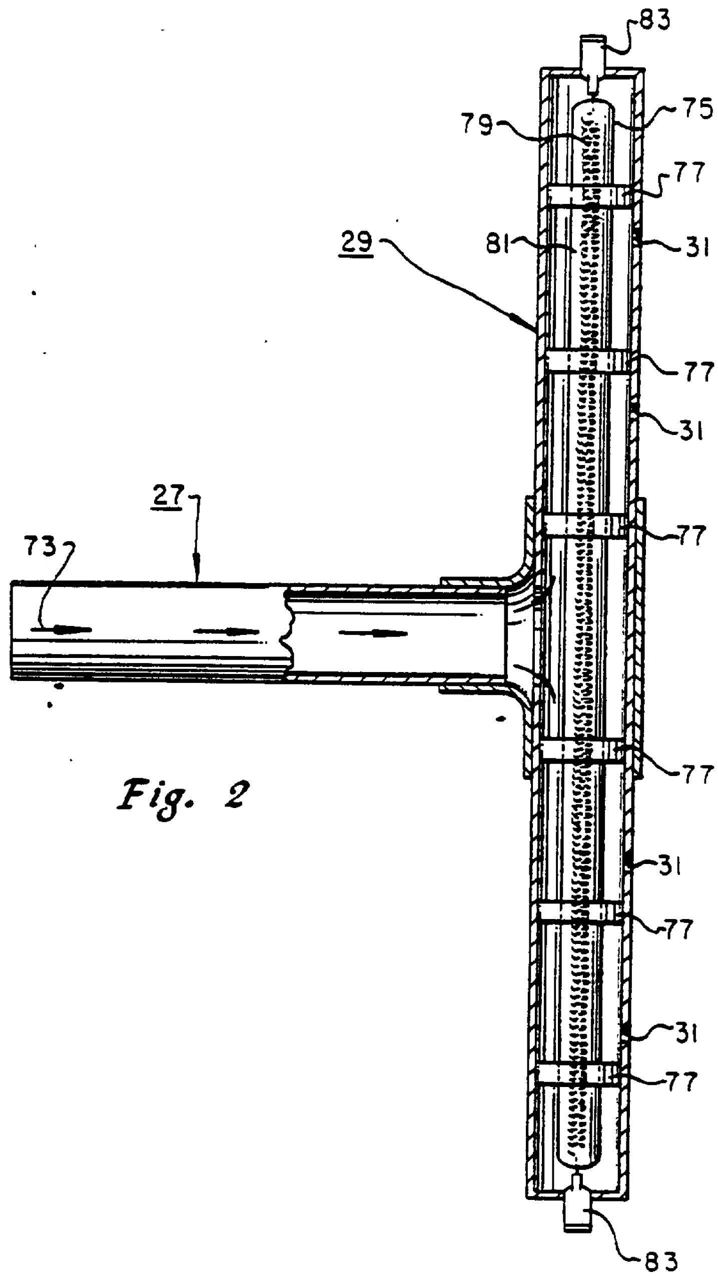

Fig. 2

APPARATUS FOR PREVENTING CONTACT OF WET INK SHEETS WITH PRINTING PRESS DELIVERY MECHANISMS AND FOR DRYING SAID WET INK

CROSS REFERENCE TO RELATED APPLICATION:

This application is a continuation-in-part of APPARATUS FOR PREVENTING CONTACT OF WET INK SHEETS WITH PRINTING PRESS DELIVERY MECHANISMS, Ser. No. 891,955, filed Aug. 1, 1986, by Jack D. Tyler, now U.S. Pat. No. 4,722,276.

BACKGROUND OF THE INVENTION

1. Field of the Invention:

This invention relates in general to printing presses, and in particular to an apparatus for preventing contact of wet ink on printed sheets with the printing press chain delivery mechanisms and for drying the wet ink on said printed sheets.

2. Description of the Prior Art:

In printing presses with chain delivery mechanisms, the sheet is drawn between a blanket cylinder and an impression cylinder, then gripped by a chain delivery mechanism and pulled rearwardly where it is deposited in a stack. The chain delivery mechanism has a pair of sprockets mounted next to the impression cylinder. A chain extends around each of the sprockets and has horizontal upper and lower runs. A gripping mechanism is mounted to the chains for gripping the leading edge of the sheet as it passes through the impression cylinder. The sprockets are mounted on a shaft that is parallel with the axis of the impression cylinder.

A long standing problem is avoiding contact of the wet ink on the sheets with the shaft that extends between the two sprockets. Any contact of the shaft with the ink will likely cause smearing. One system to avoid smearing comprises placing small wheels on the shaft. There are several different wheel designs. The wheels are preferably positioned to contact the sheet where no ink is deposited. This is not always possible. In sheets with an extensive amount of ink coverage, the wheels will contact the ink and cause smearing. Other devices have been proposed and used but not entirely satisfactorily.

Another long standing problem is that the ink is often still wet when the printed sheets are stacked. To prevent smearing at this stage, a drying powder is applied to the printed sheets. When more than one printing run is required, this powder can gum up in the printing press, causing delay, requiring maintenance, and jeopardizing the quality of the finished product.

SUMMARY OF THE INVENTION

In this invention, a nozzle having at least one opening is mounted adjacent the shaft for discharging a jet of air through a tip against the sheets as they are pulled away from the cylinders. A heating element is carried by the nozzle or tip to heat the air jet. The air pushes the sheets away from the sprocket shaft, avoiding smearing, and drying the wet ink on the printed sheets before the printed sheets are stacked. The nozzle is connected to an air compressor which supplies pressurized air. A manually operable regulator valve is located in the line for selectively varying the pressure to the nozzle. The

pressure varies substantially depending upon the type of sheets.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic view of a portion of a printing press illustrating a nozzle and heating apparatus constructed in accordance with this invention.

FIG. 2 is a view of an alternate embodiment of the apparatus constructed in accordance with this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the printing press has a plate cylinder 11 that is coated with ink. The plate cylinder 11 rotates in contact with a blanket cylinder 13. The blanket cylinder 13 includes a rubber mat or blanket mounted thereon and is coated with ink and rotates in contact with an impression cylinder 15. The image is transferred to the paper sheets 16 as they are fed between the impression cylinder 15 and the blanket cylinder 13.

The chain delivery system includes a pair of sprockets 17 that are mounted side by side immediately rearward of the impression cylinder 15. Sprockets 17 are mounted to a shaft 19 which has an axis that is parallel with the axis 20 of the impression cylinder 15. A pair of chains 21 rotate around each sprocket 17. Chain 21 has an upper horizontal run and is drawn toward the impression cylinder 15 as shown by the arrow 22. The lower horizontal run of chain 21 is drawn away from the impression cylinder 15. A gripping mechanism 23 is mounted to the chain 21 for gripping each sheet 16 as it rolls through the cylinders 13 and 15. The problem that has occurred in the past is the contact of the sheets 16 with the shaft 19 or with skeleton or star wheels (not shown) which may be mounted to the shaft 19.

Contact of the sheets 16 with the shaft 19 is prevented by a nozzle 27 which discharges compressed air. As shown in FIG. 2, nozzle 27 has a tip 29 that is a horizontal tube extending parallel with the axes of shaft 19 and impression cylinder 15 (FIG. 1). Tip 29 is mounted directly below shaft 19 in the embodiment shown and has a length that is greater than half the width of the printed sheets 16. Each end of the tip 29 is closed, making it a chamber. A plurality of circular openings 31 are formed in the forward side of the tip 29 for discharging air against the sheets 16 (FIG. 1) as they are drawn from the impression cylinder 15. In the preferred embodiment there are four openings 31 equally spaced horizontally apart from each other. A sufficient distance between the openings 31 is provided to discharge air against more than half the width of the sheets 16.

The diameter of each opening 31 is in the range from 0.02 inch to 0.06 inch and preferably 0.04 inch. Each opening 31 is preferably centered on a radial line emanating from the axis 20 of the impression cylinder 15 and passing through the axis of the tip 29. The openings 31 can also be oriented at selected angles below the radial line up to 40 degrees. The maximum discharge angle of 40 degrees is suitable for very heavy paper stock while the angle of zero degrees is suitable for paper stock of lighter weights.

Referring again to FIG. 1, the nozzle 27 is connected to a conduit 37. A pressure gauge 39 may be located in the conduit 37 and visible to the operator of the press. A manually operable regulator valve 41 will be located in conduit 37 and accessible easily by the press operator.

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Valve 41 can be rotated to provide pressures in the conduit 37 and at tip 29 that vary from about 2 psi (pounds per square inch) to 80 psi.

Conduit 37 is also connected to an on/off valve 43. Conduit 37 extends past the valve 43 to a tank 45 containing air pressure. Tank 45 is connected to a conventional compressor 47. A pressure regulator 49 senses the pressure in the tank 45 and turns the compressor 47 on and off to maintain a desired pressure in the tank 45 of about 80 psi. Valve 43 may be connected electrically to the printing press so that it will automatically turn on the air pressure to the nozzle 27 once the printing press begins to run.

A heating means 51 is carried by either the nozzle 27, tip 29, or conduit 37, and provided to heat the compressed air prior to discharge. The preferred embodiment, depicted in FIG. 1, has the heating element 51 carried between the nozzle 27 and the conduit 37.

In the preferred embodiment, the heating means 51 comprises a threaded tubular member 53 that has a central passage 55 (not depicted) for connection between conduit 37 and nozzle 27. Locking nuts 57 serve to fasten the heating means 51 to conduit 37 and nozzle 27, providing an air tight seal.

The heating means 51 further comprises a thermal jacket 59 carried by the threaded tubular member 53, a heating coil 61 disposed between the thermal jacket 59 and threaded tubular member 53, a power source 63, and temperature control means 65 electrically connected between the power supply 63 and the heating coil 61 for controlling the amount of heat supplied to the stream of compressed air that flows through the heating means 51 to nozzle 27.

The temperature control means 65 is a conventional temperature control element of the type that can be set by an operator to control the current flowing through the heating means 51. This controls the amount of heat produced by the heating means 51. It has been determined through experimentation that the optimal drying of wet ink occurs when the compressed air stream striking the printed sheets has a temperature of 90 to 200 degrees Fahrenheit. In the preferred embodiment, this result can be achieved when the nozzle 27 is positioned 1 to 3 inches away from the printed sheets.

Of course other embodiments are possible; for example, the heating means 51 may be carried by the tip 29. FIG. 2 depicts such an alternate embodiment in cross-section. Nozzle 27 directs the stream of pressurized air 73 to tip 29. A heating element 75 is disposed within tip 29, and carried by a plurality of disk-shaped thermally insulating rings 77. Said insulating rings 77 have a central passage the accommodates the heating element 75; they serve to thermally and electrically isolate the heating element 75 from the tip 29.

The heating element 75 comprises a heating coil 79 carried by a thermally conductive material 81. The heating element 75 has a tubular configuration allowing for insertion in the central passages of the insulators 77. Each end of the heating element 75 has an electrical connector 83 that protrudes from the ends of the tip 29; they are provided to allow the passage of electric current through the heating element 75.

An electric current is directed through the heating element 75. Heat is retained by thermally conductive material 81. A stream of pressurized air 73 is directed by nozzle 27 to the tip 29. This pressurized air 73 is heated by heating element 75 prior to discharge through the plurality of openings 31.

In this embodiment, the temperature provided by the heating element 75, and the distance between the nozzle 27 and printed sheets should be adjusted to ensure that the air stream is between 90 to 200 degrees Fahrenheit when it strikes the printed sheets.

In operation, an operator will turn on the press. Sheets 16 containing wet ink on one side will pass between the cylinders 13 and 15. Each sheet 16 will be gripped by the gripper mechanism 23 and pulled from the impression cylinder 15 rearwardly. The gripper mechanism 23 will deposit the sheets 16 in a stack (not shown). The valve 43 will be open supplying pressurized air to the nozzle 27 to discharge against the sheets 16 to prevent them from contacting the shaft 19. The impact of the air blows the sheets away from the shaft 19.

Normally, the operator will begin at a fairly high pressure, such as around 60 psi. He will then close the regulator valve 41 to reduce the air pressure at nozzle 27 to a minimum level that will keep the sheets 16 from contacting shaft 19. The minimum level depends upon the weight of the paper and whether the paper is coated or uncoated. The amount of pressure also depends upon the length of each sheet and can also vary depending upon the amount of ink coverage. Higher pressure than needed may cause whipping of the ends of the sheets as they are released from the impression cylinder 15. The higher pressure also expends air, and thus energy.

The temperature setting is adjusted in a similar fashion. The operator will begin at a fairly high temperature. He will then adjust the temperature setting to reduce the temperature to a minimum level that will dry the sheets to the desired extent.

For $8\frac{1}{2}\times 11$ inch paper, the following air pressures at nozzle 27 are preferred for the various types of paper: 20 pound paper, 2 psi; 65 pound cover, 18 psi; 70 pound offset, 3 psi; and 80 pound enamel, 25 psi. For 11×17 inch sheets, the following air pressures are preferred: 65 pound cover, 30 psi; 80 pound cover (50% ink coverage), 45 psi; 80 pound cover (75% ink coverage), 60 psi; 80 pound text enamel, 60 psi and 40 degree angle below a radial line extending from the axis 20 31 of the impression cylinder 15 (FIG. 1) through openings ; and 80 pound card stock 8 or 10 point, 60 psi and 40 degree angle below a radial line extending from the axis 20 of the impression cylinder 15 (FIG. 1) through openings 31. For other paper weights and types, the pressure will be selectively adjusted by the operator to a level where it is at the lowest pressure possible that will still maintain the sheets away from the shaft 19. The enamel coated stock of greater length does not have pores and tends to stick to the blanket cylinder 13 and buckle. The 40 degree nozzle helps the buckle from forming.

The invention has significant advantages. The nozzle is easily installed on existing presses. It can be adapted to various configurations of presses. It successfully keeps the wet ink on the sheets from contacting the sprocket shaft and it dries the printed sheets prior to stacking. The printed sheets can be dried to either completely or partially eliminate the drying powders currently employed to prevent the smearing of printed sheets. The nozzle apparatus is inexpensive and easy to operate.

While the invention has been shown in only one of its forms, it should be apparent to those skilled in the art that it is not so limited, but is susceptible to various changes without departing from the scope of the invention.

I claim:

1. In a printing press having an impression cylinder and a blanket cylinder, a chain delivery means for withdrawing sheets from between the cylinders including a shaft and a pair of sprockets located adjacent the cylinders carrying a chain with an upper run leading toward the cylinders and a lower run leading away from the cylinders, the shaft carrying the sprockets, and gripping means carried by the chain for engaging leading edges of the sheets to carry them away from the cylinders, an improved means for preventing the sheets from contacting the shaft while the ink is still wet, comprising in combination:

- a reservoir tank;
- an air compressor for supplying pressurized air to said reservoir tank;
- a pressure regulator for controlling said air compressor to maintain a constant pressure in said reservoir tank;
- a conduit leading from the reservoir tank to a point adjacent the shaft;
- an electrical heating element located in the conduit for heating the pressurized air to a selected temperature; and
- the conduit having a nozzle mounted adjacent the shaft and the nozzle having a tip with a plurality of openings spaced horizontally apart from each other for discharging jets of heated air against the sheets to push them away from the shaft and to dry the wet ink carried by the sheets.

2. The apparatus according to claim 1 wherein the pressurized air is heated by the electrical heating element to a temperature selected to provide a jet of heated air having a temperature substantially in the range of 90 to 200 degrees Fahrenheit when it strikes the sheets.

3. The apparatus according to claim 1 wherein the electrical heating element is located in the conduit between the compressor means and the nozzle.

4. The apparatus according to claim 1 wherein the electrical heating element is located in the nozzle.

5. In a printing press having an impression cylinder and a blanket cylinder, a chain delivery means for withdrawing sheets from between the cylinders including a shaft and a pair of sprockets located adjacent the cylinders carrying a chain with an upper run leading toward the cylinders and a lower run leading away from the cylinders, the shaft carrying the sprockets, and gripping means carried by the chain for engaging leading edges of the sheets to carry them away from the cylinders, an improved means for preventing the sheets from contacting the shaft while the ink is still wet, comprising in combination:

- a conduit leading to a point adjacent the shaft, the conduit including a nozzle having a tip that is a horizontal tube mounted immediately below and having an axis parallel with the shaft, the tip having from 2 to 6 circular openings spaced horizontally apart from each other;
- air compressor means including a reservoir tank and a compressor for supplying pressurized air to the nozzle;
- an electrical heating element carried in the conduit rearward of the nozzle openings for heating the pressurized air prior to discharge through the nozzle;
- means for controlling the amount of heat provided by the heating elements to the pressurized air; and
- wherein the pressurized and heated air is discharged against the sheets to push them away from the shaft and to dry the wet ink carried by the sheets.

6. The apparatus according to claim 5 wherein the nozzle is disposed substantially in the range of 1 to 3 inches from the sheets.

7. The apparatus according to claim 5 wherein the pressurized air is heated to a selected level sufficient to ensure that the temperature of the heated and pressurized air is substantially in the range of 90 to 200 degrees Fahrenheit when it strikes the sheets.

8. An apparatus according to claim 5 wherein the heating element is located in the tip of the nozzle.

* * * * *

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United States Patent [19]

Koehler et al.

[11] **Patent Number: 4,934,305**

[45] **Date of Patent: Jun. 19, 1990**

[54] **RETRACTABLE COATER ASSEMBLY INCLUDING A COATING BLANKET CYLINDER**

[75] Inventors: **Jamie E. Koehler**, Montreal, Canada; **James E. Taylor**, Dallas, Tex.

[73] Assignee: **Dahlgren International, Inc.**, Dallas, Tex.

[21] Appl. No.: **365,680**

[22] Filed: **Jun. 13, 1989**

[51] **Int. Cl.**[5] **B05C 1/02**

[52] **U.S. Cl.** **118/46**; 101/329

[58] **Field of Search** 118/46, 258, 262, 259; 101/329, 137, 147

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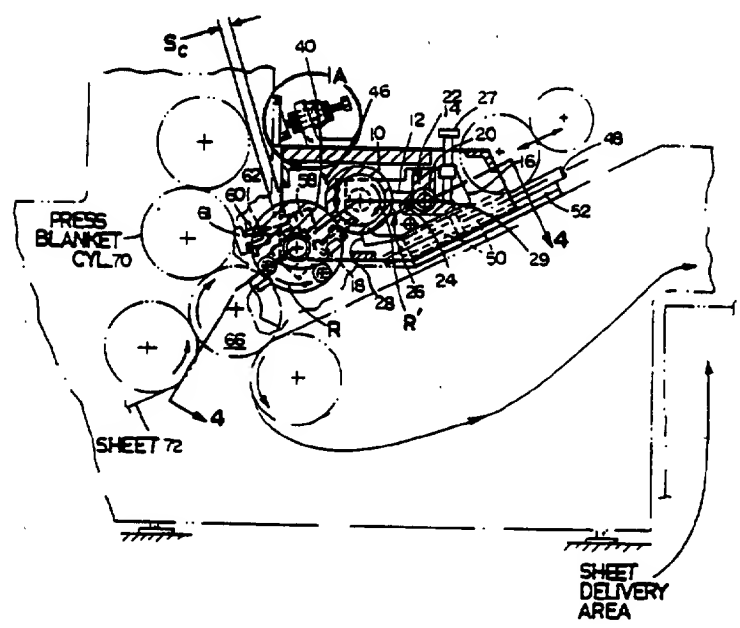
Primary Examiner—Willard Hoag

[57] **ABSTRACT**

An addition to a multi-color lithographic offset printing press comprising a self-contained coating unit moveable into and out of operative relationship with the last stage impression cylinder without interrupting or disrupting printing taking place in this last stage. The coating unit includes a special blanket cylinder, a transfer roller and doctor or metering means to control the amount of coating material on the transfer roller. Inclined tracks are provided to guide the coating unit into and out of operative relationship with the impression roller of the last printing stage.

17 Claims, 3 Drawing Sheets



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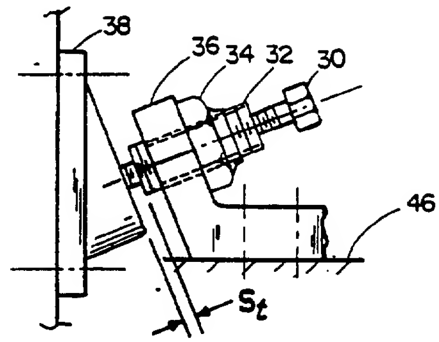
38
36
34
32
30
46
S_t

FIG. 1A

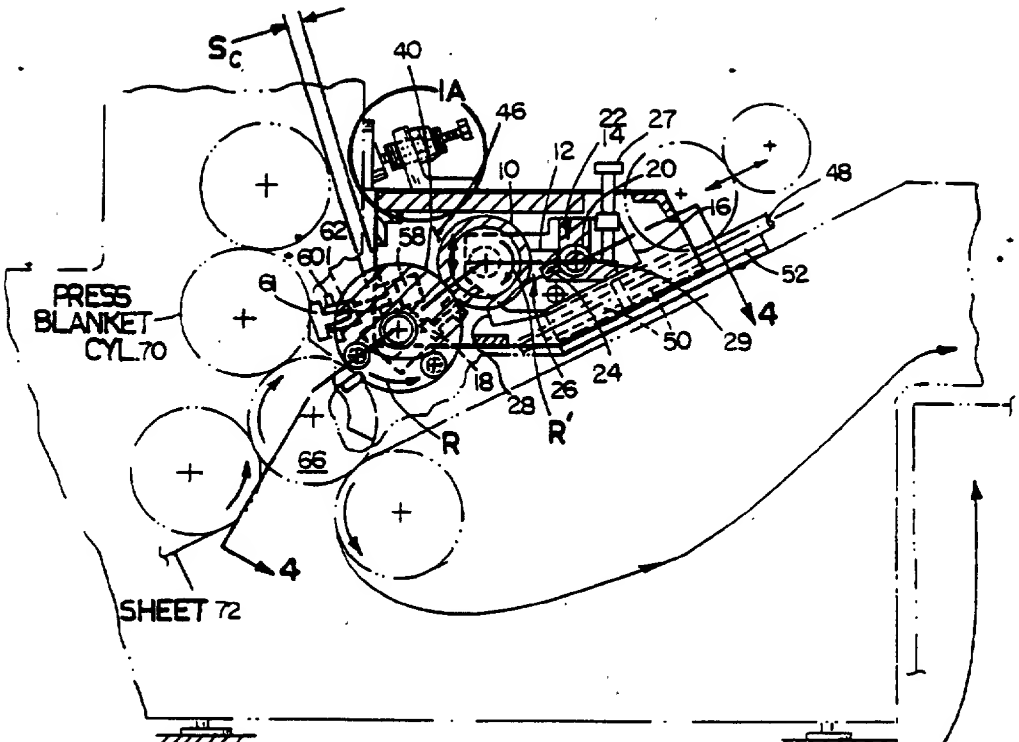
S_c
40
IA
46
22
14
27
12
10
20
16
48
62
601
58
52
61
PRESS
BLANKET
CYL. 70
4
50
29
18
26
24
28
R
R'
66
4
SHEET 72
SHEET
DELIVERY
AREA

FIG. 1

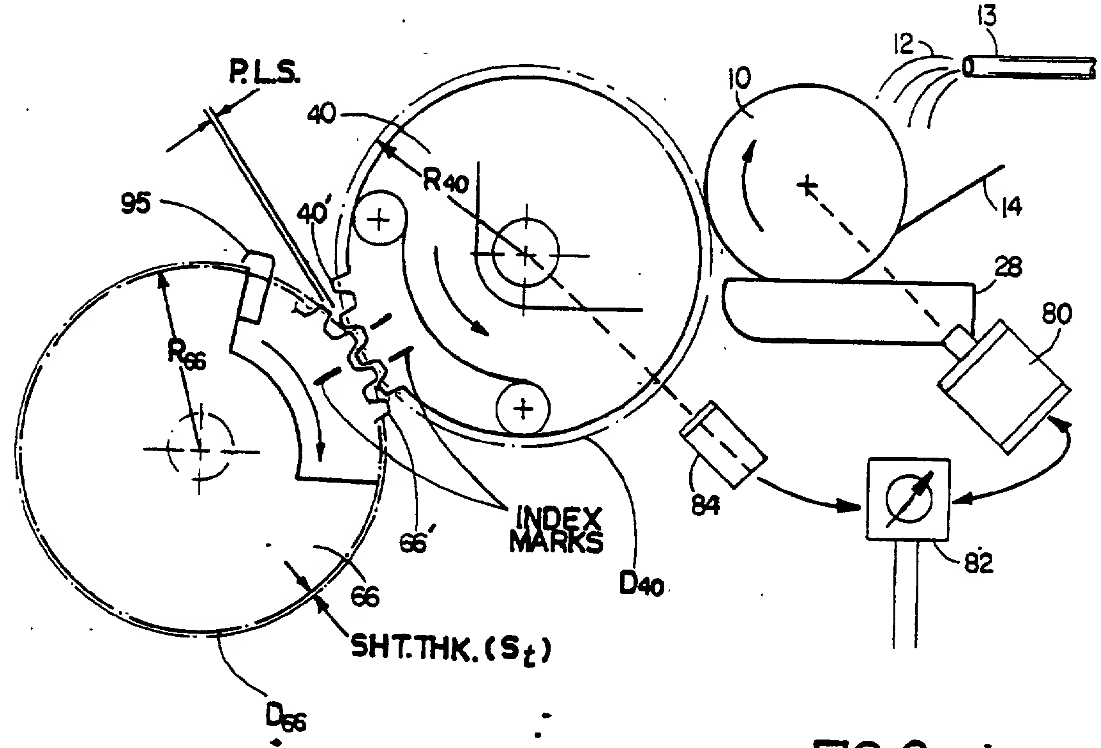
P.L.S.
40
13
12
10
R40
95
40'
14
28
80
R66
INDEX
MARKS
66'
84
82
D40
66
SHT.THK. (St)
D66

FIG. 2

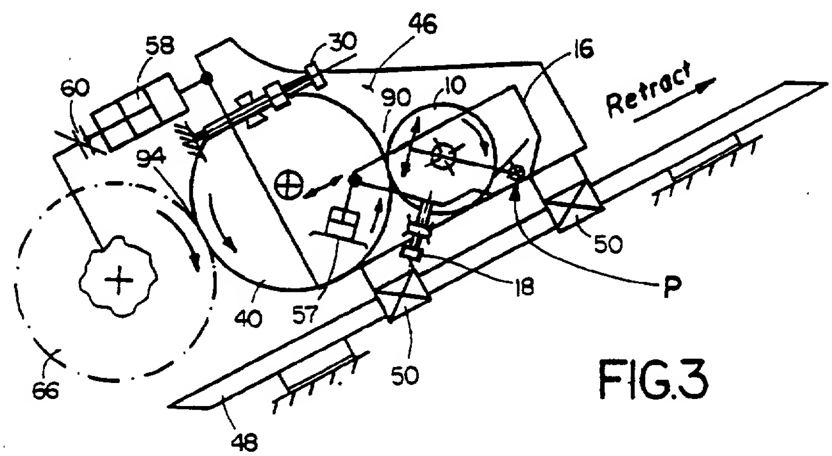
58
30
46
16
60
90
10
Retract
94
50
18
P
40
57
66
50
48

FIG.3

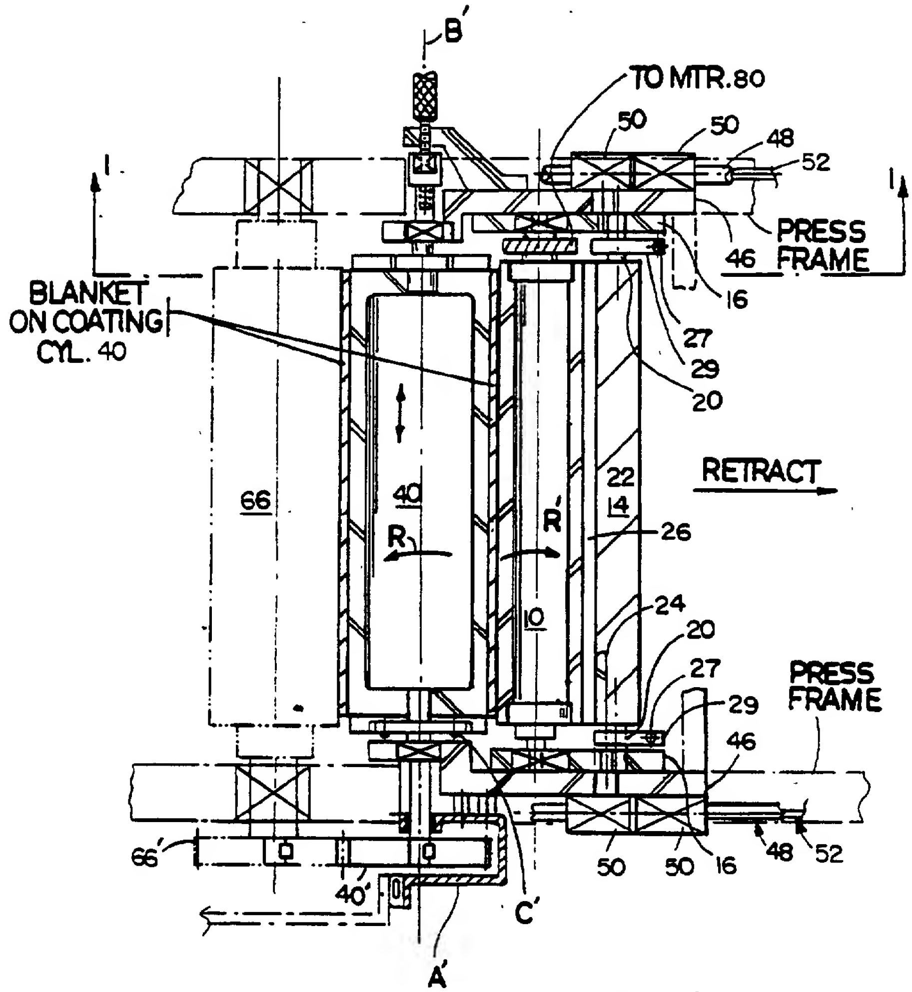
B'
TO MTR.80
50
50
48
52
PRESS FRAME
46
16
BLANKET ON COATING CYL. 40
27
29
20
RETRACT
22
14
66
40
R
R'
26
10
24
20
27
29
PRESS FRAME
46
66'
40'
50
50
16
48
52
C'
A'

FIG.4

RETRACTABLE COATER ASSEMBLY INCLUDING A COATING BLANKET CYLINDER

BACKGROUND OF THE INVENTION

This invention relates to coating printed sheets. It more particularly refers to a process and apparatus for coating sheets which have been printed on offset printing equipment.

In many applications it is desirable to apply a spot or overall coating to a printed sheet. For example, a UV curable or water-soluble polymer finish may be applied to a workpiece printed by offset lithography. The coating on the sheet is quickly dried while the surface of the ink is still tacky. This coating avoids the need for powder driers sprayed between sheets to present offsetting of oxidation-dried inks that are slow to dry. These coatings are also useful for providing a glossy finish that improves the rub-resistance of the workpiece and improves its overall appearance and feel. Finally, adhesive coatings may be applied to printed packaging; for example, heat-set adhesives may be applied to enable attachment of a feature such as clear plastic bubble of a package used to display the product. It is said that Ultraviolet cured and aqueous overprint coatings are, by some measurements, the fastest growing segments of the printing industry.

Application of coatings to a workpiece is made difficult by various requirements. For example, the coating should be uniform and its thickness should be controlled. Moreoever, the aqueous coating should be applied quickly, before its vehicle evaporates causing it to thicken. Finally, it is desirable for the coater to operate "in line" with the press that prints the workpiece to take full advantage of the fast drying capability of coatings and generally to simplify the manufacture of printed coated workpieces.

Butler U.S. Pat. No. 4,270,483 discloses an in line coating apparatus for attachment to a conventional offset lithographic printing press. The apparatus includes a set of rollers (i.e., pick-up roller 14 and application roller 16) to deliver coating material from a reservoir 18 to a standard press unit blanket roll 108. A metering rod 40 meters the amount of coating transferred to application roller 16.

An in line coater sold by Norton Burdett Co. of Nashua, N.H. has a single roller driven directly by a D.C. motor. The roller is a gravure cylinder that transfers coating to a standard press unit blanket cylinder. The coater is attached to a pivoting arm, and the unit can be pivoted away from the press unit when the coater is not in use.

Another in line coater, sold by IVT Colordry, Inc. of Fairfield, Conn., applies coating from a reservoir pan to a standard press unit blanket cylinder using a pick-up roller that delivers a coating supply to an applicator roller; the applicator roller applies the coating to the blanket cylinder of a press unit.

Kumpf U.S. Pat. No. 3,768,438 discloses a coater in which a fountain roller dips into a coating reservoir and transfers liquid coating material to a feed roller. The feed roller in turn transfers coating material to a coating roller that coats a sheet fed between the coating roller and a format roller..

Di Rico U.S. Pat. No. 4,685,414 discloses a process and apparatus for use in combination with an existing press unit wherein the coating means is retractable, to be used or not as the printer requires. In this device, the coating means utilizes the blanket roll of the last unit of the press, and this last unit cannot be used for color application means when it is used for coating. For example in a four color press, utilizing the coating apparatus of the '414 patent would then permit only three colors to be printed in in-line, single pass operation.

Bird U.S. Pat. No. 4,796,556 discloses an offset lithographic apparatus with a plate cylinder and a blanket cylinder, and an in line coater to apply liquid coatings either in a pattern or over the entire workpiece. The apparatus has a carriage which moves the coater between a first position operative association with the plate cylinder of the lithographic press unit (see full line of unit 72 in FIG. 1) and a second position in operative association with the blanket cylinder of the lithographic press unit (see broken line of unit 72 in FIG. 1). In the first position the coater applies spot coating, and in the second position the coater applies coating over the entire sheet.

Satterwhite U.S. Pat No. 4,308,796 discloses apparatus for adapting an offset lithographic press to flexographic operations, the flexographic operation being either for coating or printing. Coating is achieved by applying a photosensitive plate to the lithographic blanket roll of the offset press. A transfer roll supplies coating to the plate. Inking is achieved in a like manner but with a flexographic plate having raised image areas.

Makosch U.S. Pat. No. 4,397,237 discloses a pivoting secondary inking system ("B" in FIG. 2).

Preuss et al. U.S. Pat. No. 3,391,791 discloses a sheet coater which moves into engagement with various cylinders in a press delivery area.

Knodel et al. U.S. Pat. No. 3,916,824 discloses a coating assembly which includes a fountain roll, a metering roll and an applicator roll for coating band of ribbon material. The coater is horizontally displaceable on an auxiliary frame.

Jahn U.S. Pat. Nos. 4,615,293 and 4,706,601 disclose separate duplex coating units disposed downstream of a printing press. The units permit coating of selected portions of the workpiece using a relief plate or permit blanket coating.

Switall U.S. Pat. No. 4,617,865 discloses a coater that can be pivoted into and out of position in contact with the blanket cylinder of the press unit; the coater being retractable with the same limits as that of the Di Rico device, i.e., the coating and printing functions cannot be performed simultaneously.

Jirousek U.S. Pat. No. 2,320,523 discloses a self-adjusting dampening roll.

Edwards U.S. Pat. No. 4,222,325 discloses a retractable dampening and inking unit.

Egnaczak U.S. Pat. 3,800,743 discloses a coater for a photoelectrophoretic process.

DeLigt U.S. Pat. No. 3,397,675 discloses a coating or printing station having its applicator and transfer rolls attached to pivotally mounted supporting frames.

Some commercial presses, such as Heidelberg GTO and MO include an extra blanket cylinder e.g., for numbering, printing extra colors, perforating, center slitting, etc. This added cylinder is a fixed part of the press, and does not retract with associated equipment for numbering or imprinting.

SUMMARY OF THE INVENTION

This invention generally features apparatus that operates on line with a sheet-fed lithographic printing press

unit to apply a liquid coating to a sheet workpiece. The apparatus includes a liquid coating supply means, a special coating blanket cylinder (in addition to the blanket cylinder of the press unit), and means for metering and transfering coating material operatively connected to the coating blanket cylinder and to the liquid coating supply means, for controlling the amount of coating supplied onto the coating blanket cylinder from the supply means. Structural members integrate the means for metering and transfering coating and the coating blanket cylinder into an independent, cooperatively operating, coating assembly. The apparatus also includes a means for positively driving the coating blanket cylinder in association with the press unit impression cylinder and mounts for guiding movement of the coating assembly between an operative position, in which the coating blanket cylinder is operatively engaged with the press unit impression cylinder, and an off imprint (or off-impression) position, in which the coating blanket cylinder and drive is slightly separated from the impression cylinder (i.e., separated sufficiently to prevent contact). In the operative position the coating blanket cylinder can be accurately adjusted relative to the impression cylinder. Moreover, the coating assembly can be actuated so the coating blanket cylinder is slightly separated from the impression cylinder. Such adjustment and actuation are achieved without a change in the coating blanket cylinder position relative to the coating metering and transfer means.

The system is especially adaptable to press types such as the Heidelberg Speedmaster line of presses, where there is access on the impression cylinder of the last press unit, between the press blanket cylinder and the sheet transfer cylinder of the delivery, to add a blanket cylinder for coating. The coating blanket cylinder is adapted to provide a coating surface, which preferably is the same basic diameter as the standard printing blanket cylinder. By "adapted to provide a coating surface", we mean that the coating blanket cylinder can receive a standard resilient blanket, or it can receive a relatively hard or resilient relief plate. Alternatively, the cylinder could have a surface with permanent relief. For spot-coating, the coating blanket cylinder carries a photopolymer relief plate. This cylinder is also preferably equipped for circumferential and lateral (side) register to enable accurate positioning of the plate. Pin register may also be supplied for pre-positioning of the plate relative to the positions of upstream printing plates. Pin-register may be supplied in lieu of, or, in conjunction with circumferential and side register means. The photopolymer plate may be installed in the same blanket reels or clamps as provided for the blanket, or, may be attached to the cylinder, independent of the blanket clamping provisions.

The coating blanket cylinder continuously delivers a smooth, uniform metered amount of liquid coating material to one position of a sheet workpiece carried on the press unit impression cylinder, while at the same time, printing is immediately being applied by the press unit blanket cylinder, prior to coating, to a different position of the sheet workpiece.

Preferred embodiments of the invention are characterized as follows. The mounts guide the coating assembly to move to a fully retracted position in which the assembly and particularly the coating blanket cylinder are completely disengaged from the press unit impression cylinder at a remote location from the press unit cylinders. The coating transfer means comprises a transfer (delivery) cylinder (e.g. an engraved or smooth cylinder) in operative contact with the coating blanket cylinder, as well as a metering means (an elongated blade or a metering roll) for metering the amount of coating carried on the transfer cylinder. The coating assembly is mounted on an inclined support attached to the press frames of the delivery section of the press. Coating is circulated by recirculation means. Coating is supplied between the transfer means and the metering means, flows longitudinally along the length of the transfer and metering means and cascades at the ends thereof to a drip pan positioned below the metering means. A drip pan outlet is in operative association with the recirculation means, and the coating supply means communicates with the recirculation means, to supply recirculated coating to the transfer and metering means. The coating blanket mounted on the blanket cylinder and the press unit impression cylinder have substantially the same effective operating diameter. The apparatus includes means to control pressure or width of the nip between the transfer cylinder and the coating blanket cylinder. The apparatus also includes means to control the actuation, adjustment and speed of the transfer cylinder relative to the blanket cylinder. A gear is adapted to positively, drivingly, couple the coating blanket cylinder to the impression cylinder when the assembly is in the first (operating) position. The apparatus also includes means for adjusting the coating blanket cylinder relative to the press unit impression cylinder while the two cylinders remain drivingly engaged. An adjustable stop controls the nip between the coating blanket cylinder and the impression cylinder, without changing the relationship between the coating blanket cylinder and the liquid coating metering and transfer means. The coating blanket cylinder can be lightweight (aluminum) with means enabling lateral and/or circumferential register adjustment relative to the adjacent press impression cylinder.

This invention thus provides a direct coating system for a sheet fed printing press, preferably a multi-color press, and enables in line printing and coating at the same time on a single press unit, thus maintaining the printing capability of the printing press unit. When a press unit (preferably the final press unit) is retrofitted with the retractable coating assembly of this invention, an existing impression cylinder in the press unit acts as a common impression cylinder, so that ink is first applied to a sheet being fed on the impression cylinder and a coating is applied directly to the sheet over the last ink application. After this dual sequential application of ink and coating onto a sheet on the same impression cylinder, the coating can be suitably dried by air, infra red heat, ultra violet radiation or any other means adapted to quickly dry the coating.

This apparatus is capable of delivering a metered amount of coating through a special blanket roll to a sheet carried by the last impression cylinder in a printing press substantially without interrupting or changing the printing process. It allows spot coating or overall coating as may be desired by the printer. It operates without the use of bulky complex metering systems, yet the apparatus is versatile in that the printer can bring the coater in line or not, as he desires, without changing or interfering with an existing printing operation. Adjustment of the coating blanket cylinder and entire assembly is made relative to the impression cylinder to compensate for various sheet thicknesses to be printed. The assembly is furthermore actuatable while still drivingly

engageable with the impression cylinder, to on off positioning of the cylinder when operating in the first position.

The entire apparatus is further retractable to the second position by a simple retraction device, such as a linear-actuator, winch, hydraulic cylinder or the like (not shown), up an inclined plane (the same plane as for movement for adjustment and actuation), to provide access to: (1) the coating blanket cylinder for changing blankets, packing, clean up, maintenance, etc.; (2) the standard printing blanket cylinder; (3) the impression cylinder; and (4) the sheet delivery area, beneath the coating apparatus, housing the conventional Infra red or UV drying unit. In this second retractable position, the apparatus may be used as a seat by the operator, as desired, for standard printing press unit operation.

A gear cover is provided about the blanket cylinder gear and is designed to resiliently sealingly engage the gear cover of the printing unit to which the coating apparatus is installed. When the coating unit is retracted, a cover is supplied to seal the cutout in the press gear cover. Therefore the integrity of the oil bath is maintained within the press gear cover in both operating and retracted positions of the apparatus.

A specific sequence of actuation of the transfer roll relative to the coating blanket cylinder, and actuation of the coating blanket cylinder (and, therefore, of the entire assembly) relative to the impression cylinder for proper coating operation, is specifically discussed later herein. This apparatus is well adapted to be built into a new printing press or to be retrofited into existing equipment.

Other feathers and advantages of the invention will be apparent from the following description of the preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the coating apparatus including a diagrammatic view of a printing press with which it is operatively associated. In this FIG. the cylinders of the coating assembly are shown in solid in their coating operating position and in phantom in their retracted position. The coating apparatus is shown in section.

FIG. 1A is a side view of stop on the coating apparatus of FIG. 1.

FIG. 2 is a diagrammatic side view of a set of coating application rollers showing details of controls for positively, drivingly, linking these rollers to a printing system; and

FIG. 3 is similar to FIG. 2 showing a schematic view of controls for the coating apparatus hereof for adjustment, actuation and retraction of the coating assembly relative to the press, actuation and adjustment of the transfer roll relative to the coating blanket cylinder and the metering means relative to the transfer roll.

FIG. 4 is a cross-sectional view taken along lines 4—4 from FIG. 1.

SPECIFIC EMBODIMENTS OF THE INVENTION

This invention will be described with reference to the drawing in which like parts have been given like reference characters.

Referring now to FIGS. 1 and 4, the coating apparatus assembly of this invention comprises a transfer roller 10, journalled for rotation, onto which is fed coating material 12, and a metering assembly 14 which is suitably adjustably mounted relative to the transfer roll to deliver a predetermined quantity of liquid coating, substantially evenly along the surface of the transfer roller 10. This metering assembly 14 includes a rotatably mounted journal 20 which is generally parallel to the axis of the metering roller 10. Mounted substantially centrally about the journal 20 is a housing 22 from which a blade clamp 24 extends. A doctor blade 26 is positioned in the blade clamp 24 and is angularly positioned against the metering roller 10. The doctor blade 26 is suitably made of blue spring steel, suitably about ten thousandths of an inch thick, and suitably extends out of the clamp 24 about one-half inch. The angular position of the blade 26 may be about 40° to a tangent to the transfer roller surface. It has been found to be useful to force the doctor blade 26 against the transfer roller 10 with a pressure of about one-half to one pound per linear inch. The transfer roll (with the metering device) is mounted at each end thereof in a common frame 16 which is in turn rotatably supported in a coater assembly housing 46. Frame 16 is pivotally rotated, or otherwise moved, by cylinder 57, not shown, to adjustably engage transfer roll 10 to a lightweight (e.g , aluminum) coating blanket cylinder 40 for proper coating application. Movement of frame 16 does not affect pressure between roller 10 and blade 26. Likewise, movement of housing 46 does not affect the pressure setting, or the relative positions, of transfer roll 10 and coating blanket cylinder 40. Adjustable stop 18 is provided to set a light "kiss" pressure between roller 10 and cylinder 40.

A drip pan 28 having an outlet is provided, and is positioned below the transfer roller 10 and the metering assembly 14. The pressure exerted by the doctor blade 26 against the metering roller 10 can be adjusted by means of two adjustment screws 27 which extend to corresponding adjustment brackets 29 clamped on the axle 20. It is preferred that the adjustment screws are attached to the brackets off center with respect to the axis of the axle 20 so that the rotation of these adjustment screws will pivot the axle 20 whereby changing the pressure of the doctor blade 26 on the roller 10. A cover may be provided over the coating 12 and roller 10.

A coating blanket cylinder 40 is provided in operative, takeoff contact with the transfer roller 10. The blanket roller has its own journals rotatably mounted, suitably in needle bearings, and supportingly attached to the same housing 46 as supports the common frame 16 for the transfer roller and metering assembly. This housing 46 is slidably mounted on rails 48 which, in a preferred embodiment of this invention, are inclined so as to easily move the coating assembly into and out of the line as well as provide a guide for adjustment and actuation of the coating blanket cylinder (and entire unit) relative to the impression cylinder of the press.

Specifically, the housing 46 is mounted on bearing blocks 50 that are in turn slidably mounted on the two parallel rails 48. The rails 48 are mounted on rail supports 52 which are adapted to be directly connected to the press unit.

Hydraulic cylinders 58 each with an adjustable clevis 62 are mounted on opposite sides of the housing 46 to provide proper actuation and a "kiss" pressure contact between the coating blanket on the special blanket cylinder 40 and the sheet on press impression cylinder 66. Suitably a latch 60 is provided to insure positive positioning and lock up of the entire coating assembly with relation to the printing unit, i.e., the coating blanket cylinder 40 with the impression roller 66.

Double adjusting screws 30 and 32 are supported by support 36 attached to housing 46. Screw 30 bears against stop block 38, attached to the press frame. Screw 32 is locked by nut 34. Rotation of screw 30 provides for paper pressure adjustment and thickness changes in sheet stock, while setting screw 32 provides a safety such that gears mounted on the coating blanket cylinder and press impression cylinder, cannot be meshed beyond a preset point while in the coating mode of operation. Once nut 34 is tightened, the nut is fixed (as if it were welded or pinned) for a specific screw 32 setting. Clearance "S_c" in FIG. 1 depends on the thickness of the sheet, S_t which is generally between 0.000 to 0.030 inches. As shown in FIG. 1, clevis 62 is adjusted such that a clearance exists within cylinder 58, between the piston and cylinder wall. The piston serves as an "OFF" stop for the coating assembly when the assembly is actuated. A separation will therefore exist between the blanket and sheet when in the "OFF" impression position. For a theoretical 0.000 sheet thickness, S_c should be set for 0.060 inches approximately.

A gear-motor 80, which may be hydraulic or electric, is suitably provided to drive the transfer roll 10. Suitable motorized means is provided to retract the coating assembly into and out of operative relation with the impression roller 66, up and down the rails 48.

The coating assembly is shown in cooperative relationship with a conventional series of printing rollers. The coating blanket on blanket cylinder 40 is in light "kiss" contact with the sheet on impression cylinder 66, the sheet on the impression cylinder being also in contact with a printing blanket on blanket cylinder 70; impression cylinder 66 thereby serves as a dual impression cylinder, first for printing and next for coating. The sheet work piece is shown at 72.

The coater is first locked into operation on the press unit by lowering it along the rails 48 toward the press unit and engaging clevis 62 to lug 61 mounted on the press through releasable latch pin 60. In operation, gear-motor 80 mounted on housing 46 rotates the roller 10 as coating fluid is pumped under pressure from a fluid reservoir (not shown) to an inlet opening in the doctor blade assembly. From there, coating spreads over the surface of roller 10 and is distributed by the doctor blade 26. A continuous flow of coating is maintained over the surface of the roller 10 and excess coating is recovered through a drip pan 28, with an outlet for recycling. In this way, sufficient flow is maintained to provide a flooded nip of coating between roller 10 and blade 26 and to provide uniformity of coating along the rollers' length. The amount of coating carried by the metering roller 10 can be adjusted somewhat by turning screws 27 to adjust the pressure between doctor blade 26 (or a metering roller) and the transfer roller 10, as described above. Hydraulic cylinders 58 serve to pull the entire unit against the press with a force that can be adjusted by adjusting the pressure in the cylinders 58. Screw 30 adjusts "ON" pressure between the coating blanket on blanket cylinder 40 and a sheet carried on impression cylinder 66. Cylinders 58 further serve to separate the coating blanket cylinder from the impression cylinder while gears mounted on the adjacent cylinders still remain in mesh. Separation or clearance "S_c" in FIG. 1 is about 0.060 to 0.030 inches to provide an "OFF" condition of the coater assembly to stop application of coating. As the blanket cylinder 40 rotates in direction R, coating is applied to the just printed sheet. Transfer roller 10 rotates as shown by direction R'.

A uniform amount of liquid coating is continuously transferred to the blanket roller 40 at the nip between the blanket roller 40 and the transfer roller 10. The blanket roller 40 in turn delivers that coating to the workpiece as the workpiece travels through the nip between the blanket roller 40 and the impression roller 66. Changing the speed of roller 10 results in a change of coat weight added to the sheet.

When the coater is not in use, latch pin 60 is released, and a motorized drive moves the coating unit back along the rails 48 away from the printing rollers.

More specifically, when using an acrylic water based coating, a suitable transfer roller may be a quadrangular cell cylinder, having about 140 lines/inch, each square inch of cells carry 15 cubic billion microns of coating. A suitably engraved roller is sold by Pararco Roller Co. of Dallas, Tex. (Exact roll cell nomenclature is: 140 Roto-flo/138 for an optimum roll surface structure.) An acrylic water-based coating having about 45% solids can be applied to achieve an optimum dry coat weight of $\approx$0.4–0.6 pounds per 1000 square feet, using a roll speed of 1:1 with that of coating blanket roll 40.

Referring now to FIG. 2, there is shown a portion of a coating apparatus assembly including transfer roller 10, coating material 12 fed from a supply thereof 13 and metered onto the roller by means of a doctor blade assembly 14, including a drip pan 28. The transfer roller 10 is suitably driven by direct drive gear motor 80 whose speed is controlled by a controller 82 responding to sensor 84 which senses the speed of the coating blanket cylinder 40. Controller 82 is adjusted to provide a preset surface speed ratio, 1:1 or less, between roller 10 and cylinder 40, the slowest surface being that of roller 10. Impression cylinder 66 includes a sheet gripper 95. The coating blanket on blanket cylinder 40, and associated drive gear 40', preferably have the same operative diameter as the impression cylinder 66 and press gear 66'. Gear 40' is directly driven by press gear 66' of cylinder 66 so as to insure a positive drive relation there between. In FIG. 2, no worksheet is shown in this figure for clarity. Index marks are placed on adjacent gears to insure proper register of adjacent cylinders. The gear pitch line separation "P.L.S." is approximately equal to the sheet thickness "Sht.Thk.", S_t, shown on cylinder 66. D_{40} is a broken line corresponding to the outer diameter of the blanket on cylinder 40, and the pitch line of gear 40' and D_{66} is a broken line corresponding to the outer diameter of impression cylinder 66 and the pitch line of gear 66'. R_{40} is equal to R_{66} and thus D_{40} and D_{66} are equal.

Referring now to FIG. 3 which is similar to FIG. 2, there is shown the same three rollers, the transfer roller 10, the coating blanket cylinder 40 and the dual, common, impression roller 66. The transfer roller 10 and the coating blanket roll 40 are shown commonly mounted in assembly 46 via bearing blocks 50, on inclined rails 48. There is shown in this figure a first cylinder 57 with stop 18 which adjusts the pressure in the nip 90 between the transfer roller 10 and the coating blanket on blanket cylinder 40. A second cylinder 58 and screw 30 are provided to control the spacing in the nip 94 between the coating blanket on the blanket cylinder 40 and the dual impression cylinder 66 to accomodate a particular sheet thickness. The last color printing blanket roll 70 is not shown for clarity. Frame 16 pivots at P in FIG. 3.

FIG. 4 is a sectional view taken along lines 4—4 of FIG. 1 showing relationship or roll lengths to each other, a cover A' about the coating blanket cylinder

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drive gear, lateral and circumferential register provisions for the coating blanket cylinder, B' and C' respectively and other component parts shown in FIG. 1.

As best shown in FIG. 4, housing 46 is offset to the inside of the press frame in the area of the bearings for coating cylinder 40, and therefore clears the press frame in this area. The remainder of the housing may lie along the inclined surface of the frame; that is, directly above the frame. This offsetting of housing 46 prevents having to alter (cut away) a portion of the press frame adjacent the bearing.

For sequencing of rolls for proper coating operation, the following procedure is followed:

"ON" 1. Transfer roll actuates to coating blanket cylinder upon actuation of press blanket cylinder of last printing unit.

2. Coating blanket cylinder actuates to sheet on press impression cylinder upon one full revolution of press.

"OFF" 1. Transfer roll separates from coating blanket cylinder upon actuation of blanket cylinder of preceeding press unit.

2. Coating blanket cylinder separates from the sheet on the press impression cylinder upon actuation of the press blanket cylinder of the last printing unit.

OTHER EMBODIMENTS

Other embodiments are within the following claims. For example, other doctor blade arrangements may be used to doctor the coating from the transfer roller 10, such as a system utilizing a reverse angle blade or having dual blades and having a coating inlet between the two blades. A roll, or roller means, may also replace the doctor blade arrangement. Other types of engraved or smooth surfaced cylinders may be used. Other types of presses may be used in conjunction with the coater, but offset lithographic sheet feeding presses are preferred.

I claim:

1. An apparatus for applying a liquid coating to a sheet workpiece, said apparatus being adapted for operation on line with a unit of a sheet-fed lithographic printing press, said press unit comprising a press unit blanket on a press unit blanket cylinder engageable at a first printing location on a sheet workpiece on a press unit impression cylinder; said apparatus comprising:

a liquid coating supply means;

a coating blanket cylinder adapted to provide a coating surface;

a means for metering and transferring liquid coating material operatively connected to said coating surface on said coating blanket cylinder and to said liquid coating supply means, for applying a controlled amount of coating on said coating surface of said coating blanket cylinder;

structural members integrating said means for metering and transferring coating material and said coating blanket cylinder into an independent, cooperatively operating, coating assembly;

means for positively driving said coating blanket cylinder in association with said press unit impression cylinder; and

mounts for guiding movement of said coating assembly between an operative position in which said coating surface on said coating blanket cylinder is operatively engaged with a second location on said sheet on said press unit impression cylinder and an off imprint position in which said coating surface on said coating blanket cylinder is slightly separated from said sheet workpiece on said press unit impression cylinder, said coating assembly including said means for metering and transferring coating material, remaining intact during movement of said coating assembly;

whereby in said operative position, said coating surface continuously delivers a smooth, uniform, metered amount of said liquid coating material to said sheet workpiece on said impression cylinder at said second location on said impression cylinder while printing is being applied by said press unit blanket to said sheet workpiece at said first location on said impression cylinder.

2. The apparatus of claim 1 wherein said means for metering and transferring coating comprises a transfer cylinder in operative contact with said coating surface on said coating blanket cylinder and means for metering the amount of coating carried on said transfer cylinder.

3. The apparatus claimed in claim 2 wherein said means for metering is a doctor means comprising an elongated blade edge positioned against said transfer cylinder.

4. The apparatus claimed in claim 1 wherein said coating assembly is mounted on an inclined support.

5. The apparatus claimed in claim 1 further including a drip pan positioned below said metering and transferring means comprising an outlet, and recirculation means in operative association with said outlet, said liquid coating supply means communicating with said recirculation means to deliver recirculated liquid coating material to said means for metering and transfering.

6. The apparatus claimed in claim 1 wherein said coating surface on said coating blanket cylinder and said impression cylinder have substantially the same effective operating diameter.

7. The apparatus claimed in claim 2 including means to control the nip betwen said transfer cylinder and said coating surface on said coating blanket cylinder.

8. The apparatus claimed in claim 1 including a gear adapted to positively couple said coating blanket cylinder to said impression cylinder when said coating assembly is in said first operating position.

9. The apparatus of claim 1 further comprising means for adjusting the coating blanket cylinder relative to the impression cylinder, while the coating blanket cylinder remains drivingly engaged with the impression cylinder.

10. The apparatus of claim 9 comprising an adjustable stop to control the nip between the coating surface on said coating blanket cylinder and the workpiece sheet on said impression cylinder, without changing the coating blanket cylinder relationship to the liquid coating metering and transfer means.

11. The apparatus of claim 1 wherein the coating blanket cylinder is a lightweight cylinder.

12. The apparatus of claim 1 wherein said coating blanket cylinder further comprises means for circumferential register with the adjacent press impression cylinder.

13. Apparatus of claim 12 wherein the coating blanket cylinder further has means enabling lateral register adjustment relative to the adjacent press impression cylinder.

14. Apparatus according to claim 13 wherein said coating blanket cylinder is adapted to receive a photopolymer plate and wherein said means for metering and transfering coating comprises a transfer cylinder, the surface of which is a transfer surface, said transfer sur-

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face and the surface of said photopolymer plate being adapted for rotation together in nip contact at substantially the same surface speeds for precision spot coating to said sheet workpiece.

15. Apparatus according to claim 1 wherein said mounts guide said coating assembly to move to a fully-retracted position in which said coating assembly and coating blanket cylinder are completely disengaged from said press unit impression cylinder at a remote location from the press unit cylinders.

16. Apparatus according to claim 1 wherein said blanket cylinder is adapted to receive a blanket for coating said sheet workpiece.

17. Apparatus according to claim 1 wherein said blanket cylinder is adapted to provide a coating plate at its surface.

* * * * *

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United States Patent [19]

Pensavecchia et al.

[11] **Patent Number:** **4,936,211**

[45] **Date of Patent:** **Jun. 26, 1990**

[54] **MULTICOLOR OFFSET PRESS WITH SEGMENTAL IMPRESSION CYLINDER GEAR**

[75] Inventors: **Frank G. Pensavecchia**, Hudson; **Richard A. Williams**, Hampstead, both of N.H.; **John P. Gardiner**, Chelmsford, Mass.; **Stephen M. LaPonsey**, Merrimack; **John F. Kline**, Hudson, both of N.H.

[73] Assignee: **Presstek, Inc.**, Hudson, N.H.

[21] Appl. No.: **234,474**

[22] Filed: **Aug. 19, 1988**

[51] **Int. Cl.**[5] **B41F 7/10**

[52] **U.S. Cl.** **101/136**; 101/177; 29/159.2

[58] **Field of Search** 51/287; 101/137, 136, 101/140, 177, 174, 185, 467, 450.1, 175, 216, 217; 29/159.2

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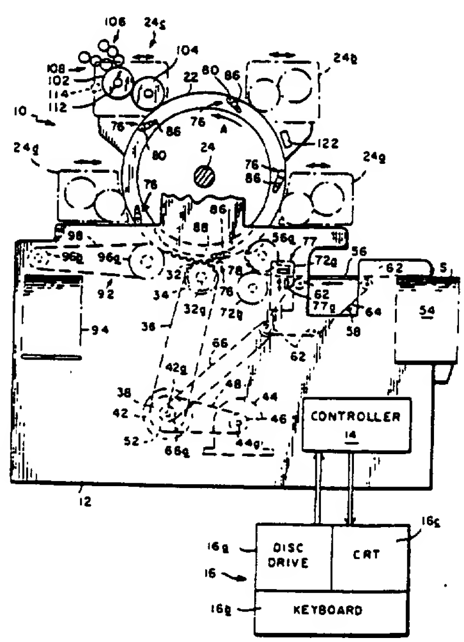
Primary Examiner—Clifford D. Crowder

Attorney, Agent, or Firm—Nutter, McClennen & Fish

[57] **ABSTRACT**

A low cost press able to print high quality continuous tone color copies comprises a single large diameter impression cylinder rotatably mounted to the machine frame. A plurality of print stations are spaced around the impression cylinder, each print station including a blanket cylinder in rolling contact with the impression cylinder and a plate cylinder in rolling contact with the blanket cylinder, the diameters of all of said plate and blanket cylinders being substantially the same and said impression cylinder having a diameter that is the same as or an even number more than the product of the plate cylinder diameter multiplied by the number of plate stations in the press. The cylinders are all rotatably coupled together by correspondingly sized gears so that they all rotate in unison with the impression cylinder gear being composed of arcuate parallel-cut segments having identical tooth profiles.

28 Claims, 3 Drawing Sheets



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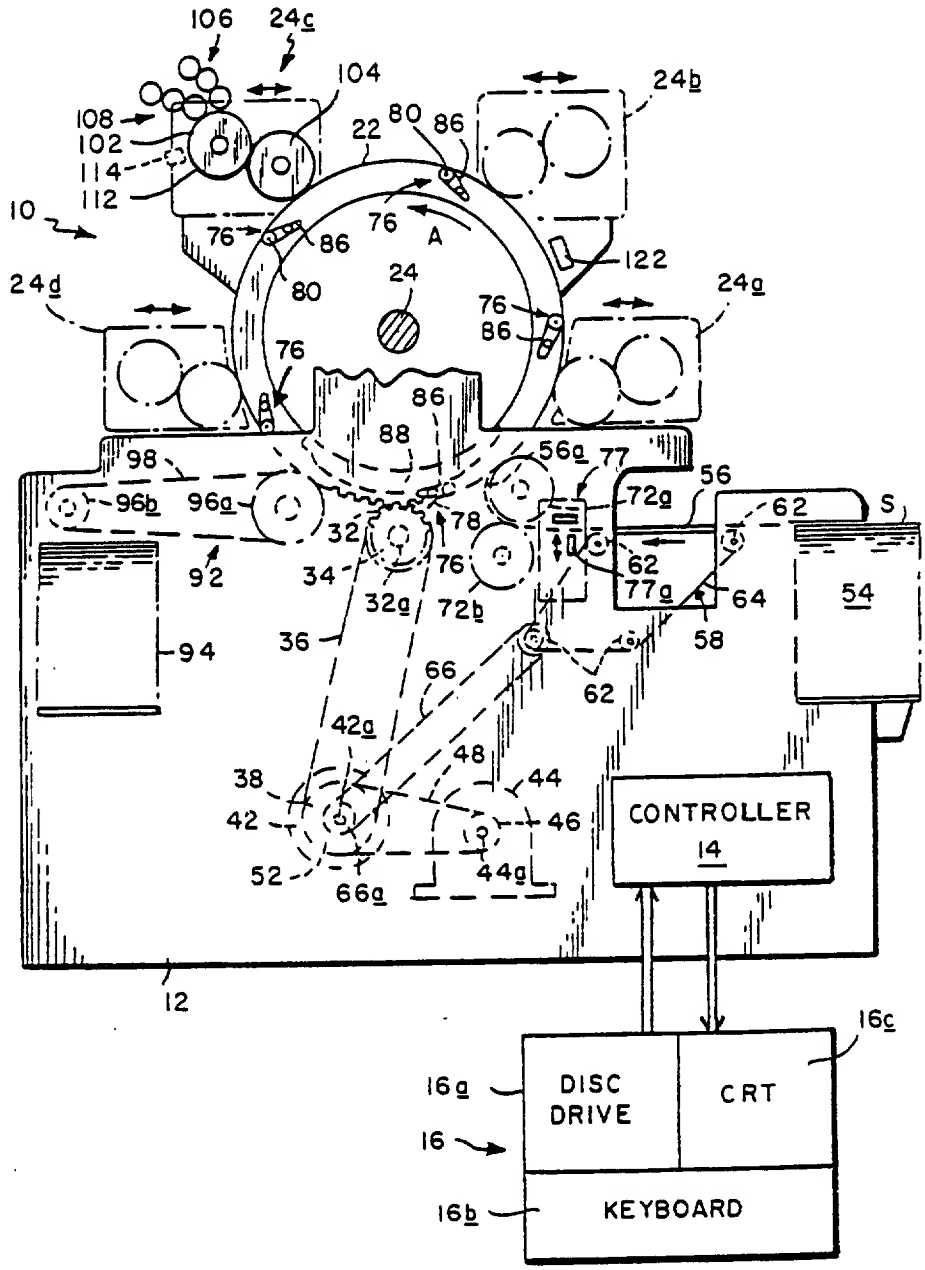
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24c
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24b
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24a
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86
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77
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96b
96a
72a
62
S
32
78
62
34
76
77a
64
54
92
32a
72b
58
94
36
66
62
42a
48
38
44
42
46
CONTROLLER
14
52
44a
66a
12
16c
16a
DISC
DRIVE
CRT
16
16b
KEYBOARD

FIG. I

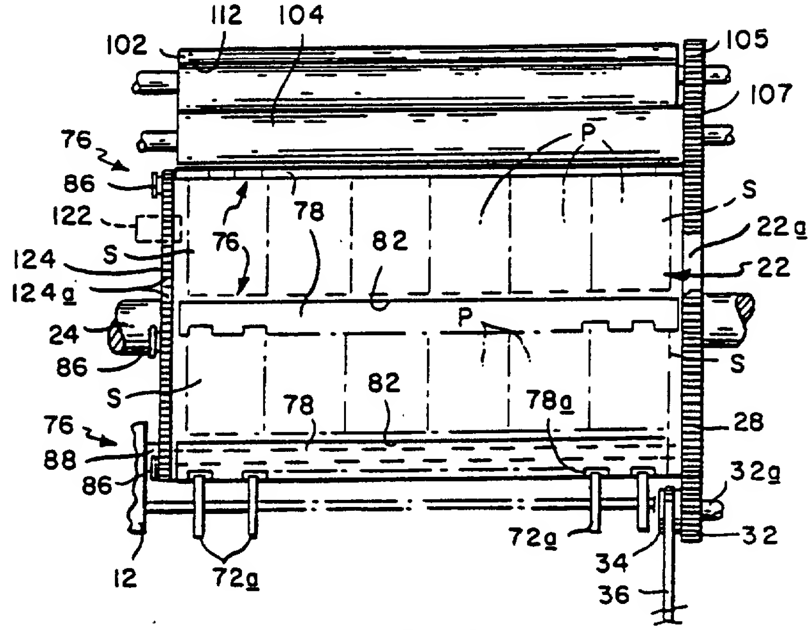


FIG. 2

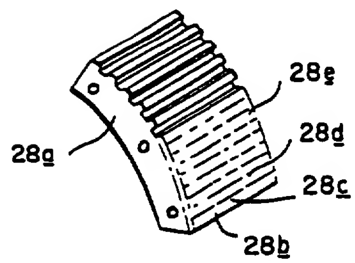


FIG. 4

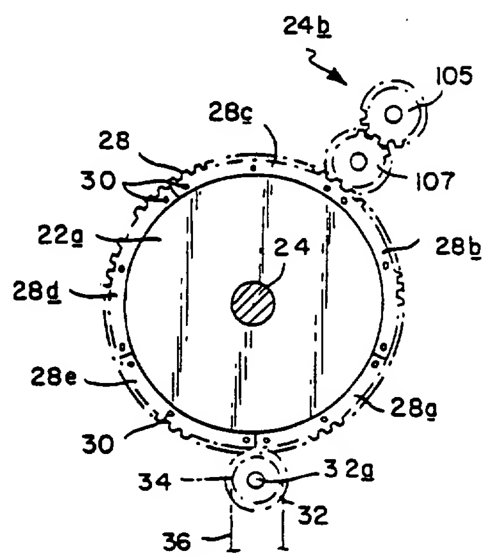
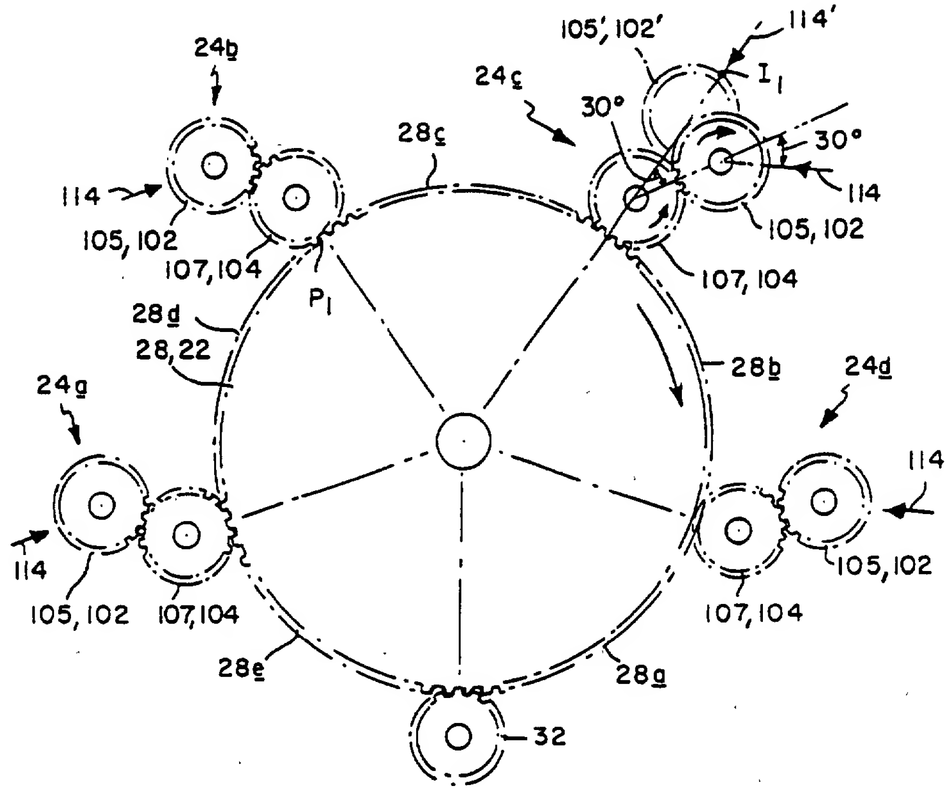


FIG. 3


24b
114
105, 102
107, 104
P_1
28c
24c
105', 102'
114'
I_1
30°
30°
114
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107, 104
28d
28, 22
28b
24d
24a
114
105, 102
107, 104
114
105, 102
107, 104
28e
28a
32

FIG. 5

MULTICOLOR OFFSET PRESS WITH SEGMENTAL IMPRESSION CYLINDER GEAR

This invention relates to printing method and means. It relates more particularly to improved apparatus for printing high quality copies in color and to the printing method carried out by that apparatus.

BACKGROUND OF THE INVENTION

There are a variety of known ways to print hard copy. To name a few, the traditional techniques include rotogravure printing and offset lithography. Both of these printing methods require a plate which bears an image of the original document or picture to be copied and usually the plate is loaded onto a plate cylinder of a rotary press so that copies can be made efficiently. In the case of gravure printing, the plate cylinder is inked and the inked image thereon is impressed directly onto the paper or other copying medium. In the case of lithography, the image is present on a plate or mat as hydrophyllic and hydrophobic surface areas. Water tends to adhere to the water-receptive or hydrophyllic areas of the plate creating a thin film of water there which does not accept ink. The ink adheres to the hydrophobic areas of the plate. Those inked areas, usually corresponding to the printed areas of the original document (direct printing), are transferred to a relatively soft blanket cylinder and that, in turn, applies the image to the paper or other copying medium brought into contact with the surface of the blanket cylinder by an impression cylinder.

While certain aspects of the present invention are applicable to both kinds of printing and the approach can be applied to any number of colors including one as will be pointed out in more detail later, we will describe the invention in the context of a sheet-fed four-color offset press.

The plates for an offset press are usually produced photographically. In a typical negative-working subtractive process, the original document is photographed to produce a photographic negative. The negative is placed on an aluminum plate having a water-receptive oxide surface that is coated with a photopolymer. Upon being exposed to light through the negative, the areas of the coating that received light (corresponding to the dark or printed areas of the original) cures to a durable oleophyllic or ink-receptive state. The plate is then subjected to a developing process which removes the noncured areas of the coating that did not receive light (corresponding to the light or background areas of the original) and these non-cured areas become hydrophyllic (water loving). The resultant plate now carries a positive or direct image of the original document.

If a press is to print in more than one color, a separate printing plate corresponding to each color is required, each of which is usually made photographically as just described. In addition to preparing the appropriate plates for the different colors, the plates must be mounted properly on the plate cylinders in the press and the positions of the cylinders coordinated so that the color components printed by the different cylinders will be in register on the printed copies.

In most conventional presses, the printing stations required to print the different colors are arranged in a straight line or flatbed approach. Each such station contains all of the elements required to print a single color, including an impression cylinder, a blanket cylin-

der, a plate cylinder and the necessary ink and water systems for applying ink and water to the plate cylinder. The equaldiameter plate and blanket cylinders at each station are geared to the impression cylinder there and the latter is geared to the impression cylinders in the other stations so that all of the press cylinders rotate in unison to maintain registration of the different color components of each copy.

To make a copy on that type of press, a sheet of paper is fed to the first print station where its leading edge is gripped and the sheet wrapped around the impression cylinder at that station. The press then operates to print onto the sheet, say, the cyan color component of the original document being copied, after which that sheet is discharged to the second printing station of the press. At station No. 2, the leading edge of the sheet is picked up by a second gripper and wrapped around the impression cylinder of that station. The press then operates to print a second, e.g. the yellow, color component of the original document onto the paper sheet, after which the sheet is discharged to the third printing station which grabs the sheet and prints the third color component, i.e. magenta, onto the sheet. In four-color printing, the sheet passes through a fourth station which prints a black image onto the sheet. Thus, successive paper sheets are fed into the press, are printed on at the various print stations thereof, and then exit the press carrying a three or four-color image of the original document or picture.

A conventional press such as the one just described has several drawbacks. First of all, since it consists essentially of three or four single color presses arranged one after the other, it occupies a considerable amount of floor space. A present day four-color press of this type can be as long as 20 feet. Secondly, the sheet has to be picked up and wrapped around the impression cylinder at each print station of the press. Thus, in a four-color press, four separate operations are required to position the sheet for printing. This means that each printing station must have its own paper feeding and handling mechanisms. Not only does this increase the cost of the press, it also introduces print registration errors into the printed copies.

Normally in a press, misregistrations are corrected for by manually or automatically adjusting the relative positions of the plate cylinders at the various print stations in a proper rotational, axial, and skew-orientation phase. It has been proposed that by imaging the plates "on press" the time required to correct for misregistration will be substantially decreased. The imaging of the plates can be controlled by incoming image signals representing the original document to be copied or reproduced in high volume. Indeed, it has been proposed to image an offset plate on the press using an ink jetter. The ink jetter is controlled so as to deposit on the plate surface a thermoplastic imageforming resin or material which has a desired affinity for the printing ink being used to print the copies.

While that proposed system may be satisfactory for some applications, it is not always possible to provide thermoplastic image-forming material that is suitable for jetting and also has the desired affinity (phyllic or phobic) for the inks commonly used to make lithographic copies. Further, ink jet printers are generally unable to produce small enough ink dots to allow the production of smooth, continuous tones on the printed copies, i.e. the resolution is not high enough.

In any event, such manual, automatic or electronic registration correction procedures are not totally satisfactory for a sheet fed press because the registration errors due to the multiple grippings of each sheet are random errors that cannot be corrected completely by onetime adjustments of the plate cylinders or of the images thereon. Nor are such procedures effective to correct for misregistration due to random gearing errors caused by variations in the tooth profiles of the meshing gears that drive the various cylinders of the press. These tooth profile variations arise in the process of cutting the gears and they are more noticeable in large diameter gears.

Since such random errors are not normally correctable, press manufacturers have had to resort to minimizing the problem by using very accurate paper feeding mechanisms and precision gearing. Such precision parts are quite expensive and materially increase the overall cost of the press. Also, as alluded to above, the misregistration problem is not completely eliminated and can still manifest itself in a press intended to print high quality, high resolution copies, which is the type of press we are primarily concerned with here.

Thus, although considerable effort has been devoted to improving different aspects of printing, including lithographic printing, there still does not exist a compact, relatively low cost printing apparatus or press whose printing plates or cylinders can be formed right on the press using incoming digital data representing original documents or pictures to enable the printing in long or short runs of high quality continuous tone color reproductions or copies. It would, therefore, be highly desirable if such apparatus could be made available particularly as a relatively compact sheet fed press and at a cost affordable to printers and other businessmen who want to do high quality printing and publishing in-house.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide printing apparatus in the nature of a press which can print economically, in both long or short runs, high quality copies in black and white and in color.

Another object of the invention is to provide a press of this type whose printing plates can be imaged right in the press using image signals from any available source.

Another object of the invention is to provide an offset press which minimizes registration errors in the copies being printed.

Still another object of the invention is to provide printing apparatus of this type which compensates electronically and mechanically for registration errors that are introduced into the printing process.

Yet another object of the invention is to provide a sheet fed color press which prints in three or four colors using only a single impression cylinder thereby reducing the need to compensate for registration errors caused by page handoffs of the printed copies.

Still another object of the invention is to provide such printing apparatus which achieves complete computer control over the entire printing process, including plate generation, ink regulation and the start up, print, hold, shut down and cleanup stages of the actual printing operation.

Yet another object of the invention is to provide a method of color printing which minimizes registration errors in the printed impressions.

Other objects will, in part, be obvious and will, in part, appear hereinafter.

The invention accordingly comprises the several steps in the relation of one or more of such steps with respect to each of the others and the apparatus embodying the features of construction, combination of elements and arrangement of parts which are adapted to effects of steps, all as exemplified in the following detailed description, and the scope of the invention will be indicated in the claims.

Briefly, our printing apparatus is designed to accept electronic signals that represent color-separated images that are to be printed. It is implemented as a sheet-fed offset press. However, whereas prior presses of this type comprise a series of more-or-less self-contained print stations arranged one after another in a line, in our press, the print stations are disposed around a single large diameter impression cylinder, there being one station for each color. Thus, a four-color press has four offset print stations positioned around the impression cylinder, the stations all being similar to one another and the equal diameter plate and blanket cylinders therein being geared directly to the impression cylinder. When the press is operating, the paper sheets to be printed on are fed successively from a stack to the impression cylinder as that cylinder rotates. Circumferentially spaced clamping mechanisms on the cylinder grab successive fed sheets on the fly so that the sheets become wrapped and properly positioned around the impression cylinder and are advanced successively past print stations, in turn, so that each paper sheet is printed with a plurality of colors. The printed sheets are then stripped successively from the impression cylinder and stacked in a conventional manner.

To maximize the printing rate, the press is designed so that successive paper sheets are being printed by all of the print stations simultaneously. This means that the circumference of the impression cylinder must be large enough so that a number of paper sheets corresponding the number of print stations, e.g. four, can be wrapped around the cylinder at the same time. On the assumption that the plate cylinder at each print station is large enough to print a full-size image on one sheet of paper, this means that the diameter of the impression cylinder must be at least equal to the diameter of the plate cylinder multiplied by the number of print stations. In practice, the impression cylinder diameter can be larger than that product so that while the sheets are being printed at the four print stations, the press can also be in the process of loading a fresh sheet onto the impression cylinder and stripping a fully printed sheet from that cylinder. Thus, for a four color press, the diameter of the impression cylinder can be more than four times larger than the plate cylinder diameter. Actually, for reasons to be discussed presently, the two diameters should also differ by an even multiple. Thus, in a four color press, the impression cylinder should be exactly four, five, six, etc. times larger than the plate cylinder. In a three color press, the multiple would be three, four, five, etc.

It can be appreciated that there is a distinct advantage to arranging all of the print stations around a single large impression cylinder in that each sheet being printed on is clamped to the impression cylinder only once and is rotated past all four print stations before being released to the delivery end of the press. Since each sheet remains clamped on the impression cylinder during the entire printing process, there is less apt to be registration errors due to movement or mispositioning

of the sheets. Also, the grouping of the print stations around a single impression cylinder materially reduces the floor space required by the press. Indeed, a press incorporating our invention requires only about one-third the linear floor space necessary to site a conventional four color offset press.

Each print station of our press includes equal-diameter plate and blanket cylinders and the usual ink and water systems that apply ink and water to the lithographic plate on the plate cylinder. Preferably, the ink system or fountain is of the type that permits automatic ink flow adjustment. The cylinders at all of the printing stations are geared directly to a unitary gear on the impression cylinder so that all of the cylinders rotate in unison. However, instead of being a unitary gear, this gear is specially constructed of five identical arcuate sections which are assembled on the impression cylinder to form a circular gear having essentially the same diameter as the impression cylinder. The gear thus divides the circumference of the impression cylinder into five arcuate printing sectors, (one for each of the four sheets being printed on and one extra to allow for loading and unloading sheets), each of which is equal to one printing period, i.e. one revolution of each plate cylinder. This means that if there are any gearing errors in the coupling of the plate and impression cylinders, the errors will be periodic around the circumference of the latter gear. Being non-random, those errors can now be corrected or compensated for by adjusting the relative phases of the plate cylinders or of the images thereon.

While the lithographic plates on the plate cylinders at the various print stations may be conventional ones, more preferably, they are of a type that can be imaged "on press" by imaging apparatus, e.g. lasers, at the print stations which respond to incoming image signals representing the respective color components of the original document or picture being printed by the stations. Such on-press imaging eliminates registration errors due to mispositioning of the plates on the plate cylinders. It also allows nonrandom or periodic color registration errors to be corrected automatically by electronically controlling the relative phases of the plate cylinders or the timing of the picture signals being applied to the imaging apparatus at the various print stations so that the images applied to the plates are shifted appropriately in phase. In the event that the printing plates are imaged on press by imaging apparatus at each print station, registration due to random gearing errors can be minimized further by proper placement of the imaging apparatus. More particularly, the imaging or writing head, e.g laser, spark discharge electrode, etc. should be positioned opposite the plate cylinder so that an image dot applied to that cylinder will offset to the impression cylinder or, more particularly, to a paper sheet thereon, after the plate cylinder has rotated exactly 360°. With this constraint, if there are any random gearing errors at any particular print station, these same errors will be repeated in each identical sector of the impression cylinder gear that defines a printing period or sector on that cylinder. Resultantly, the same image dot will offset to the impression cylinder at exactly the same location in each printing sector thereof. In effect then, the random gearing errors are rendered cyclical or periodic so that they can be compensated for electronically by appropriately controlling the timing of the signal applied to the imaging head that produces that image dot.

Preferably, our press includes a computer terminal or workstation which allows an operator to input data representing an original document or picture to be printed, as well as a keyboard to permit the operator to key in instructions regarding the particular press run, e.g. the number of copies to be printed, the number of colors in the printed copies, etc. The computer also allows complete control over the operating modes of the press including printing plate imaging (if applicable), press startup procedure, ink flow regulation, dampening, print, pause, as well as shutdown and clean-up sequences. Desirably also, the workstation includes a CRT display and the necessary internal memory to allow storage of the impression or image data so that the impression to be printed can be previewed before printing.

The press also includes provision for making ink adjustments automatically depending upon the actual number of dots of each color in different bands across the image, as opposed to the average number of color dots over the entire picture area. This provides very accurate control over ink usage and avoids the need of having a skilled technician present to effect the ink regulation manually. This also minimizes the amount of paper waste during set up.

A press made in accordance with this invention can print copies with as many as 1016×1016 dots/inch (pixels/inch), with each dot being as small as 1/2000 in.^{2}. The dots can be printed side by side or in an overlapping relation to produce smooth, continuous color tones in the printed copies. The press allows the printing of quick proofs as well as a large quantity of proofs in the event that distribution of same is required to a number of different people. If corrections are required, the corrections can be entered at the prepress workstation and new plates created reflecting the necessary changes. Then corrected copies can be printed on a small volume basis or in quantity. If unusually long print runs are required, e.g. in excess of 10,000 copies, new printing plates identical to the previous ones can be made from the data already stored on the press workstation. With all of these advantages, then, our press should find wide application wherever there is a need to print high quality color copies at reasonably low cost and with a great amount of flexibility in the printing operation.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description, taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view of an offset color press incorporating our invention;

FIG. 2 is an end view of a portion of the FIG. 1 press;

FIG. 3 is an elevational view showing the opposite or gear side of a portion of the FIG. 1 press;

FIG. 4 is an isometric view illustrating the manufacture of the impression cylinder gear shown in FIG. 3;

FIG. 5 is a diagrammatic view of the FIG. 3 gear side of the press illustrating the operation of the press.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawings, the illustrative embodiment of our press, shown generally at 10, is a freestanding, sheet-fed four-color offset press. The components of the press are mounted on an upstanding machine frame 12 which normally rests on the floor and is only about seven feet long. The press includes an

internal controller 14 which receives input data and control signals from a separate workstation 16 connected to controller 14 by suitable cables. The press responds to digital signals representing an original document or image and since the press is a four color press, up to four separate strings of color signals are involved representing the color separations for cyan, yellow, magenta and black. These image signals may be stored on a disk and applied to the press by way of a disc drive 16a at workstation 16. Alternatively, they may arrive from a computer, telephone line or other source. Control signals for the press are entered by an operator via a keyboard 16b at the workstation. Using the keyboard, the operator may enter instructions for imaging the printing plates on press, e.g. instructions relating to press control such as ink flow adjustment, number of copies to be printed, etc.

Referring now to FIGS. 1 and 2, rotatively mounted on frame 12 is a large diameter impression cylinder 22 having a central axle 24 journaled in opposite sides of the machine frame 12. Typically, cylinder 22 is in the order of 94 inches in diameter. Disposed around cylinder 22 are four substantially identical print stations 24a, 24b, 24c and 24d which print the four colors cyan, yellow, magenta and black, respectively. Preferably the stations are supported by frame 12 as mirror image pairs on opposite sides of cylinder 22 as shown in FIG. 1.

As best seen in FIGS. 2 and 3, one end of cylinder 22 is milled to form a reduced diameter shoulder 22a on which seats a special circular gear 28 to be described in greater detail later. It suffices to say at this point that gear 28 is secured to the end of cylinder 22 by bolts 30 (FIG. 3) and it has substantially the same outer diameter as that cylinder. Meshing with gear 28 is a drive gear 32 rotatively mounted to the machine frame via the main drive shaft. Coaxially fixed to gear 32 is a pulley 34 which is connected by a belt 36 to a pulley 38 fixed to the output shaft 42a of a transmission 42 mounted at the bottom of frame 12. The transmission 42 is driven by an adjacent electric motor 44 having an output shaft 44a carrying a pulley 46 connected by a V-belt 48 to a pulley 52 on the input shaft (not shown) of transmission 42. In the illustrated press, cylinder 22 is rotated counterclockwise as shown by arrow A in FIG. 1.

Individual paper sheets S are fed to the impression cylinder 22 from a tray 54 at the righthand side of press 10 as viewed in FIG. 1. At appropriate points in the rotation of cylinder 22, while the cylinder continues to rotate, the topmost paper sheet S in tray 54 is picked from the stack and carried along a guide 56 leading towards cylinder 22 by a more or less conventional paper feeding mechanism or feeder shown generally at 58. The paper feeder 58 basically comprises an array of pulleys 62 mounted to the machine frame around which are trained one or more belts 64, the lowermost pulley 62 being rotated by a drive belt 66 which extends down to a pulley 66a on the output shaft 42a of transmission 42. The paper feeder 58, which may include picker fingers or suction means on each belt 64, picks up and carries each paper sheet S from tray 54 to the impression cylinder 22.

The paper feeder delivers the paper to a registration station shown generally at 77. At this station, the leading edge of the paper is stopped by vertically movable fingers 77a that register it to be parallel to the axis of the impression cylinder. Once this is done, the paper is moved toward a side guide (not shown), by any conventional means, to assure that it has been squared up and is in the correct axial position relative to the impression cylinder. Since this is a four color press, the registration accuracy required at this station is that required to allow printing on both sides of the page as opposed to the high precision required for color dot location.

Before each sheet S reaches impression cylinder 22, its leading end is guided by an upwardly curved lefthand end segment 56a of guide 56 through the nip of one or more pairs of upper and lower accelerating rollers or wheels 72a and 72b. These rollers are rotated by conventional means (not shown) so that their surface speeds exceed that of impression cylinder 22. Thus, just before it reaches the cylinder, the leading end segment of each sheet is accelerated upward directly toward the surface of cylinder 22.

As shown in FIGS. 1 and 2, cylinder 22 is provided with a circumferential array of paper clamping or gripping assemblies shown generally at 76. Each assembly 76 comprises an elongated gripper 78 which is rotatively mounted by pivots 80 at its opposite ends in a lengthwise slot 82 in cylinder 22. Each gripper is notched at 78a to provide clearance for wheels 72a. Also as best seen in FIG. 1, the pivot 80 at the lefthand end of gripper 78 extends through the adjacent end wall of slot 82 and is rotatably fixed to one end of a cam following lever 86 positioned adjacent to the lefthand end of cylinder 22. The opposite end of lever 86 is thus free to swing radially in and out. When the free end of each lever 86 is in its outer position as shown at the bottom of cylinder 22 in FIG. 1, the associated gripper 78 is in its open position as shown there so that it is able to receive or intercept the leading end of a paper sheet S. On the other hand, when the free end of each lever 86 in its radially inner position as shown at the top of cylinder 22 in FIG. 1, the associated gripper 78 is in its closed position wherein it lies flush against the surface of the cylinder.

Each gripper 78 is spring-biased toward its closed position and it is opened only when the associated lever 86 encounters an arcuate cam 88 fixedly mounted to frame 12 adjacent to the lefthand end of cylinder 22 as viewed in FIG. 2. The cam is located adjacent to a lower angular sector of the cylinder, (i.e. between 5 and 7 o'clock), so that when the cylinder is rotated to position one of the levers 86 opposite the cam, the associated gripper 78 is moved to its open position. Thus, before it is advanced opposite to the paper guide end segment 56a that gripper is ready to receive the leading end of the sheet S then being advanced by the paper feeder 58 to cylinder 22. Immediately thereafter, the lever 86 leaves the camming surface of cam 88 allowing gripper 78 to snap to its closed position thereby gripping that sheet so that the sheet becomes wrapped about the cylinder as that continues to rotate.

As shown in FIG. 1, the cylinder 22 in press 10 has five such gripping assemblies 76 distributed at equal angles around the cylinder. Each time a paper sheet S is fed to the cylinder and is gripped by a gripper 78, that entire sheet is advanced past all four print stations 24a to 24d before being released to a printed copy delivery station shown generally at 92 at the opposite side of the press below print station 24d. Conveyor 92 comprises a conventional mechanism for transporting paper sheet S from the surface of cylinder 22 to a receptacle 94 for printed copies. The conveyor is illustrated here as simply a pair of rollers 96a, and 96b carrying endless belts 98 which may support pickers or suction means (not shown) for pulling the trailing end of a sheet S from the

surface of cylinder 22 after that sheet has been released by the lowermost gripper 78 opened by engagement of its lever 86 with cam 88, as shown at the bottom of cylinder 22 in FIG. 1.

Thus, press 10 is able to print on four successive paper sheets S simultaneously at the four print stations 24a to 24d, while a fifth fully printed sheet is being picked from the cylinder by the delivery station 92, and a fresh paper sheet is about to be loaded onto the cylinder by paper feeder 58. The press may include other known mechanisms such as paper guides, rollers, pickers, suction mechanisms, etc. to facilitate loading and offloading of the paper sheets. Actually, each sheet S may comprise of a number of document pages or image areas P as indicated in FIG. 2, the actual number depending upon the length of the press cylinders and the size of the image.

As mentioned previously, the print stations 24a to 24d are substantially identical. Therefore, we will describe only one of them, e.g. print station 24c, in detail. Station 24c comprises a plate cylinder 102 which makes surface contact with a blanket cylinder 104 of the same diameter, and that, in turn, is in surface contact with impression cylinder 22. More or less conventional ink and water systems 106 and 108, apply ink and water, respectively, to the surface of plate cylinder 102. Preferably, the ink fountain of the former system includes means for automatically controlling ink flow so that the amount and distribution of ink applied to the plate cylinder can be regulated by signals from press controller 14. One suitable fountain of this type is disclosed in U.S. Pat. No. 4,058,058. Preferably also, the print station 24c is slidably or pivotably mounted on machine frame 12 as shown by the double-headed arrows in FIG. 1 so that its blanket cylinder 104 can be moved into or out of contact with impression cylinder 22.

While certain aspects of the present invention can be incorporated into presses that have conventional print stations, most preferably, the print stations 24a to 24d of press 10 are the type described in U.S. Pat. No. 4,911,075, entitled LITHOGRAPHIC PLATES AND METHOD AND MEANS FOR IMAGING THEM, which patent has common ownership with the present application. Accordingly, the full disclosure in that justreferenced patent is hereby incorporated herein by reference. Suffice it to say at this point that the print station described there allows the imaging of a lithographic plate 112 by a scanning imaging or write head section 114 when the plate is mounted on the plate cylinder 102. While the write head section disclosed in that application is of the spark discharge type, it should be understood that for purposes of the present invention, the imaging means may be any type of device such as laser, stylus, electrode, etc. capable of imagewise exposing or otherwise altering the surface of plate 112 so as to impress an image on the plate in response to exposure signals applied to it by press controller 14.

The plate 112 carrying the image of the original document or picture to be copied is inked and dampened in the usual way by systems 106 at 108 and that inked image is transferred to the blanket cylinder 104 and from there to the paper sheets S wrapped around the impression cylinder 22. For certain types of lithographic plates 112, both water and ink from the systems 108 and 106, are coated onto the surface of the plates. Other types of plates 112 require no water from the water system 108 and accordingly, that system may be disabled or deactivated. Examples of such plates 112 used in so-called wet and dry lithography are described in the aforesaid application. In both types of lithography, however, the objective is to transfer an inked image from the plate cylinder 102 via the blanket cylinder 104 to the paper or other recording medium on impression cylinder 22.

As described previously, impression cylinder 22 is of a size to allow the four print stations 24a to 24d to print four different color images on four separate paper sheets S simultaneously. To accomplish this effectively and efficiently, it is essential that the relative positions of the images being printed on sheets S by the four print stations be precisely known and controlled. Otherwise, the four different color images printed on each sheet S will be out of register with respect to each other.

The fact that all of the sheets S are mounted on a single large impression cylinder while being printed on by all four print stations 24a to 24d contributes greatly to the ability of press 10 to print the different color components of each impression in register. This is because, as noted above, each paper sheet S is gripped at the surface of plate cylinder 22 only once. Therefore, the position of that sheet is fixed while the sheet is rotated into contact with the blanket cylinders 104 of all four print stations. Only then is the sheet released to the delivery station on 92. This is in sharp contrast to the situation in prior serial-type presses which grip and release each sheet at separate impression cylinders of the four print stations in the series. Obviously, such multiple gripping or handing off of each sheet can cause variations in the position of the sheet from station to station. These positional variations tend to be more or less random. Therefore, they are difficult to compensate for either mechanically or electronically. The usual solution has been to try to minimize the problem by resorting to complex and expensive feeding and positioning mechanisms at the various print stations. However, that solution is not feasible here where one of the prime objectives is to provide a relatively low cost press that can print high quality copies.

The use of a large impression cylinder 22 in press 10 produces an ancillary advantage in that the position or phase angle of cylinder 22 at any given time can be detected or monitored with a high degree of accuracy. In the illustrated press, this is accomplished by means of a magnetic detector 122 positioned on machine frame 12 opposite a large diameter steel strap or band 124 extending around the lefthand end of cylinder 22 as shown in FIG. 2. Band 24 has etched lines or makes 124a around its circumference. Detector 122 detects these marks and develops position signals which are applied to controller 14. The controller is thus able to monitor the angular position of impression cylinder 22 and, on the basis of that information, to control the timing of the various press functions. In the illustrated band 124, the marks 124a are spaced 0.008 inch apart. A phase lock oscillator in controller 14 divides the signals from detector 122 into eighty parts so that position signals are provided every 0.0001 inch or approximately every 0.0004 degree of rotation of cylinder 22. Since the blanket cylinders 104 and the plate cylinders 102 are all geared directly to the impression cylinder gear 28, the relative positions of those cylinders are also known to a high degree of accuracy.

Gear 28 is not simply of an arbitrarily large size, however. Rather, its diameter is related precisely to the diameters of gears 105 and 107 on the plate and blanket cylinder 102 and 104 respectively. More particularly, as

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noted previously, the impression cylinder 22 has at least as many paper sheet positioning or printing sectors as there are print stations; cylinder 22 actually has five such sectors, the extra one being for paper feed and let off as described above. In accordance with the present invention, gear 28 has a diameter that is exactly five times larger than the identical diameters of the plate and blanket cylinder gears 105 and 107. This means that gear 28 and the impression cylinder 22 can be divided into five printing periods or sectors, one for each sector on cylinder 22 at which a sheet S can be positioned for printing, the sectors being measured from sheet leading edge to leading edge. Furthermore, when gear 28 and cylinder 22 rotate through one printing period or sector, the plate and blanket cylinders 102 and 104 at the four printing stations will make one complete revolution to transfer complete images to the sheets S in the cylinder sectors opposite those respective stations. Theoretically then, after gear 28 has rotated through one printing period or sector, each plate and blanket cylinder gear 105 and 107 will have rotated exactly 360° to position their gear teeth at exactly the same positions vis a vis the next period of the impression cylinder gear 28 as they had at the beginning of the first period so that the positions of the inked images on the plate and blanket cylinders relative to paper sheets S on cylinder 22 will be the same for all printing periods.

In practice, however, this close relationship is usually not maintained due to gearing errors resulting from the cutting of the gears. In other words, when cutting or hobbing gears, particularly large diameter gears, the gear tooth profiles are not identical all around the gear. While these gearing inaccuracies may not be important in most applications, they are here where angular variations of the cylinders of as little as 0.0008 degree must be avoided. Furthermore, when the gearing errors arise in a satellitettype gearing arrangement of the type present in press 10, they give rise to print registration errors which are random in nature and, therefore, cannot be corrected or compensated for either mechanically or electronically. Until now, the only solution to this problem has been to provide costly precision gearing in color presses of this general type.

Press 10 greatly reduces misregistration due to such gearing errors by making gear 28 as five identical arcuate segments 28a to 28e, one for each printing period, as shown in FIGS. 3 and 5. The gear segments 28a to 28e are made identical by stacking the segment blanks in parallel in the hobbing or gear cutting machine as shown in FIG. 4 so that the corresponding teeth of each gear segment are all cut simultaneously and therefore identically. Each gear segment is cut down the middle of the base of a tooth so that when the segments are assembled on cylinder shoulder 22a as in FIG. 3, they form a complete circular gear. After the gear segments have been angularly positioned properly on cylinder shoulder 22a, they are anchored tightly in place by bolts 30 which extend through holes in the gear segments and are threaded into the end of cylinder 22.

The just described segmenting of gear 28 does not completely avoid all gearing errors in press 10. Rather, since the gear segments 28a to 28e are identical and since each such segment corresponds to one complete revolution of the plate and blanket cylinder gears 105 and 107, gearing errors that are present will repeat themselves during each printing period and will manifest themselves as cyclical or periodic registration errors in the printed copies. Those periodic gearing errors may be compensated for electronically when applying the images to the printing plates 112 as described in the above application.

When the plates 112 are imaged on press, the plate cylinder 102 and the write or imaging head 114 should be located relative to the impression cylinder 104 so that an image element or dot applied to the plate cylinder will arrive at the common tangent of the blanket cylinder and impression cylinder after the plate cylinder has rotated exactly 360°. In this way, that same dot will be handed off to the impression cylinder, or more particularly to a sheet S thereon, at exactly the same mechanical gearing point in each printing sector of cylinder 22. This aspect of registration correction can best be understood with reference to FIG. 5 which shows the angular relationships of the impression cylinder gear 28 and the plate and blanket cylinder gears 105 and 107 and the imaging head 114 at each print station 24a to 24d. Note that this figure, like FIG. 3, shows the side of the press opposite to the side shown in FIG. 1.

Referring to print station 24c, if the plate cylinder gear 105, blanket cylinder gear 107 and the imaging head 114 were all arranged in a straight line on a radius of the impression cylinder gear 28 as shown in phantom at 102', 105', 114' in FIG. 5, an image dot I applied by head 114' to cylinder 102' would offset onto cylinder 22 or, more particularly, the paper sheet S thereon, after gears 105', 107 (and cylinders 102', 104) have rotated exactly 360° so that a printed spot P_1 would appear at exactly the same point in the following printing sector of cylinder 22. In other words, since the gear sectors 28a to 28e are identical, identical gear teeth would be engaged during both the imaging and transferring times.

However, as a practical matter (when one considers packaging restraints), it may not be possible to provide such a straight line arrangement of cylinders and head 114 at each printing station 24a to 24d. Due to inking and dampening requirements and space constraints at each print station, the plate and blanket cylinders usually cannot both be positioned with their axes on a straight line from the center of the impression cylinder. However, if the imaging head 114 at each print station is positioned so that it has the same angular relationship to the line defined by the axes of the plate and blanket cylinder gears 105, 107 as that line has to the line defined by the center of the blanket and impression cylinder gears 107, 28, any misregistration due to gearing errors at that print station will be exactly the same when printing in all of the printing periods or sectors of the impression cylinder.

In other words, the imaging head 114 should be angularly offset around the plate cylinder by the same amount that the axis of that cylinder is offset from the line extending from the center of the impression cylinder through the center of the blanket cylinder. In FIG. 5, this offset angle is shown (for example) as about 30° so that the imaging head 114 should be positioned with a 30° offset as shown. Since the print stations 24a to 24d are substantially identical, the other heads 114 are similarly offset 30° (in the opposite sense in the case of the mirror image stations 24a and 24b).

Cyclical mechanical errors that cannot be compensated for mechanically as aforesaid (i.e. axial misalignment and skew) can be compensated for electronically. More particularly, a dot position look-up table may be included in controller 14 which stores the x and y coordinates of all dot positions. By performing a so-called end-to-end test using plates imaged with simple test

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patterns (e.g. vertical and horizontal lines), copies are printed. If certain color lines deviate from the theoretical true position, the differences are measured and suitable x and y offsets are entered into the look-up table at the locations therein corresponding to the offending dots of the particular color. This calibration step would be performed only once at the factory during the final check-out phase of press manufacture and the corrected dot positions for each color permanently stored in the press controller as the pedigree for each of the four print stations. Subsequent similar calibration would be required only in the event that certain parts of the press, e.g. gearing, had to be replaced.

To operate press **10** in its imaging mode, the operator inserts a disk, tape, or any form of digital storage media carrying digital data representing the color separations of the original document to be copied and loads that data into the internal memory of the work station **16** and/or controller **14**. The operator can then call up that data and preview the image on the display **16c** before printing. Upon operator command, the controller **14** is caused to actuate the imaging heads **114** using that image data thereby applying corresponding images to the plates **112** on plate cylinders **102**. The press can then be operated in its print mode to print proof copies of the original document, the number being determined by the operator's instructions entered via keyboard **16b**. If the colors printed on the copies are acceptable, the operator can instruct the press to print the required number of final copies. If changes are required, new printing plates **112** can be made using appropriately corrected image data from the prepress system.

It is even feasible to make each plate cylinder **102** house a plate material cassette containing a length of imagable flexible mat or film that can be automatically advanced around the plate cylinder to locate fresh lengthwise segments of the mat or film on the cylinder surface. In this way, a plate **112** with a satisfactory and properly registered image can be created very quickly and efficiently. The old image will be rolled up inside of the plate cylinder at the same time as the new material is dispensed.

The operator can also regulate ink flow at each print station using keyboard **16b** in the event that is deemed advisable from examining the printed copies in the course of a printing run. Further, the controller **14** can be programmed to automatically control the adjusting screws along each ink fountain doctor blade to set the screws in accordance with the amount of ink required across the image based on a count of the number of dots of each color to be printed in the band controlled by each adjusting screw.

Optionally, by addition of a densitometer, it is possible to achieve a fully automatic closed loop color adjusting system. The initial settings of the doctor blades may be based on a dot count done by the controller/computer as previously described. Using an "on the fly" color densitometer, the various colors (within the color bar) can be scanned, and the results fed back to the computer. The computer will compare the densitometer readings to the original dot count analysis and make new doctor blade adjustments, if needed. These steps can be repeated as many times as required. Once the process is completed, the data (per print station) can be stored as the pedigree of each and every color station. This color pedigree or fingerprint can then be used for the set up of the next printing job. By this approach, each successive job should come closer to final settings from the outset.

The controller is also programmed to automatically control the other usual press operations such as start up, shut down and clean-up.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in carrying out the above method and in the construction set forth without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention described herein.

What is claimed as new and desired to be secured by Letters Patent of the U.S. is:

1. Printing apparatus comprising a machine frame; a large diameter impression cylinder rotatably mounted to the frame; a plurality of print stations spaced around the impression cylinder, each said print station including a blanket cylinder rotatively mounted to the frame and in rolling contact with said impression cylinder and a plate cylinder rotatably mounted to the frame and in rolling contact with said blanket cylinder, the diameters of all of said plate and blanket cylinders being substantially the same and said impression cylinder having a diameter that is equal to or larger than the product of the plate cylinder diameter multiplied by an integer, and each cylinder including a correspondingly sized circular gear fixed coaxially to rotate with that cylinder, the blanket cylinder gear of each print station meshing with both the plate cylinder gear and the impression cylinder gear at that station, said impression cylinder gear being composed of a plurality of arcuate gear segments whose arc lengths are equal to the circumferences of the plate and blanket cylinder gears, the corresponding teeth of all of said impression cylinder gear segments having tooth profiles which are substantially indentical having been cut in parallel simultaneously by the same gear cutting tool so that gearing errors are periodic around the impression cylinder gear.

2. The printing apparatus defined in claim 1 wherein the impression cylinder diameter is an integer multiple of the plate cylinder diameter.

3. The printing apparatus defined in claim 2 wherein said integer is four or more and said rotating means rotates said impression cylinder.

4. The printing apparatus defined in claim 1 wherein the number of gear segments is the same as or an integer number more than the number of print stations.

5. The printing apparatus defined in claim 1 and further including means on the impression cylinder for releasably gripping the leading edge of a sheet, said gripping means being movable between gripping and releasing positions; means for feeding sheets one-by-one to said impression cylinder for gripping by the gripping means when the latter are in their releasing position; means for stripping each sheet from the impression cylinder when said gripping means are in their releasing position, and means for moving the gripping means between said two positions so that the gripping means are in their releasing position only over a relatively small selected sector of the angular motion of the impression cylinder that is not disposed opposite a print station whereby each fed sheet, upon being gripped by

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said gripping means, is wrapped about the impression cylinder and advanced past all of said print stations before being stripped from the impression cylinder by said stripping means.

6. The printing apparatus defined in claim 5 wherein said impression cylinder carries a plurality of said gripping means spaced around its circumference, the number of same being at least equal to the number of print stations in the press.

7. The printing apparatus defined in claim 6 wherein the number of gripping means is equal to the number of times that the impression cylinder diameter is longer than the plate cylinder diameter.

8. The printing apparatus defined in claim 1 wherein each print station also includes image receiving means on the surface of the plate cylinder thereat, and means for applying an image to the image receiving means at that station and further including means for receiving color separated electronic image signals representing the different color components of an original document and control means responsive to said signals for controlling the imaging means at each print station so that they apply a color separated image to the image receiving means on the plate cylinder at that station.

9. The printing apparatus defined in claim 8 wherein each said imaging means comprise a scanning energy source selected from the group consisting of laser, spark electrode and light emitter.

10. The printing apparatus defined in claim 8 wherein said control means process said signals to position each image on an image receiving means so as to compensate for said gearing errors that affect the angular position of each of said plate cylinders with respect to the impression cylinder.

11. The printing apparatus defined in claim 1 wherein each print station also includes an ink system for applying ink to said plate cylinder thereat, said ink system including means responsive to control signals for regulating the amount of ink applied to the corresponding plate cylinder along its length, and control means for providing control signals to said regulating means at each print station, said control means counting the number of image dots to be formed by each print station on selected portions of said plate cylinder and controlling said ink system for that print station based on the number of dots to be printed by that print station on said plate cylinder portions.

12. The printing apparatus defined in claim 11 and further including color densitomiter means for sensing colors in the printed matter printed by the printing apparatus, means for comparing the densitomiter means readings with the dot count for each print station to produce a color correction signal and means for applying said correction signal to said control means to readjust the number of dots to be printed by that station on said plate cylinder portions.

13. Printing apparatus comprising a machine frame; a relatively large diameter first cylinder rotatably mounted to the frame; a circular gear coaxially fixed to said first cylinder, said gear having a diameter that is substantially the same as that of the first cylinder and being composed of a plurality of separate arcuate segments, the corresponding teeth of all of said gear segments having substantially identical tooth profiles having been cut in parallel simultaneously by the same gear cutting tool, each said gear segment defining a printing sector of said first cylinder; a plurality of substantially identical second cylinders rotatably mounted to said frame in rolling contact with said first cylinder at spaced-apart locations around the first cylinder; a corresponding plurality of second cylinder gears coaxially fixed to said second cylinders, said second cylinder gears having the same diameter as said second cylinders and being in mesh with said circular gear, the arc length of each of said circular gear segments being equal to the circumferences of said second cylinder gears.

14. The printing apparatus defined in claim 13 wherein the number of gear segments is the same as or an integer number greater than the number of second cylinders.

15. The printing apparatus defined in claim 13 and further including a third cylinder rotatably mounted to said frame in rolling contact with a unique one of said second cylinders; a third gear coaxially fixed to each of said third cylinders, each said third gear having the same diameter as and being in mesh with, the second cylinder gears; means for rotating said first cylinder gear; imaging means movably positioned adjacent to each of said third cylinders to scan a raster on the surface of the corresponding third cylinder, and means for actuating each imaging means in response to color separated electronic image signals at selected points in the scan of said imaging means to apply a color separated image in the form of dots to the surface of the corresponding third cylinder.

16. The printing apparatus defined in claim 15 and further including means on the impression cylinder for releasably gripping the leading edge of a sheet, the number of gripping means being equal to the number of times that the impression cylinder diameter is longer than the plate cylinder diameter and each gripping means being movable between gripping and releasing positions.

17. The printing apparatus as defined in claim 15 and further including means for controlling the actuating means so as to compensate electronically for cyclical errors in the placements on copies of the half tone color dots printed by said printing apparatus.

18. Printing apparatus comprising a frame; a relatively large diameter first cylinder rotatably mounted to said frame; a first circular gear coaxially fixed to said first cylinder for rotation therewith, said first gear having essentially the same diameter as said first cylinder and being composed of a plurality of separate arcuate sectors the corresponding teeth of all of said sectors having identical tooth profiles having been cut in parallel simultaneously by the same gear cutting tool; at least one second cylinder rotatably mounted to said frame in rolling engagement with said first cylinder; at least one second circular gear coaxially fixed to said at least one second cylinder for rotation therewith, said at least one second gear having the same diameter as said at least one second cylinder and being in mesh with said at least one first gear; at least one imagable third cylinder rotatably mounted to said frame, said at least one imagable third cylinder having the same diameter as, and being in rolling engagement with, said at least one second cylinder and at least one third circular gear coaxially fixed to said at least one third cylinder for rotation therewith, said at least one third gear having the same diameter as, and being in mesh with, said at least one second gear, the arc length each of said first gear sectors being equal to the circumference of each of said at least one second and third gears.

19. The printing apparatus defined in claim 18 wherein there are a plurality of corresponding second

and third cylinder and gear sets comprising separate print stations spaced around said first cylinder, the number of first gear segments being equal to or exceeding the number of print stations, each print station also includes an ink system for applying ink to said plate cylinder thereat, said ink system including means responsive to control signals for regulating the amount of ink applied to the corresponding plate cylinder along its length, and control means for providing control signals to said regulating means at each print station.

20. The printing apparatus defined in claim 18 and further including means for applying ink to the surface of each third cylinder and means responsive to ink control signals for adjusting each applying means to regulate the distribution of ink along each third cylinder, and control means for providing said ink control signals to each said adjusting means, said control means counting the number of image dots to be formed by each print station on selected portions of said third cylinder and controlling said adjusting means for that print station based on the number of dots to be printed by that print station on said third cylinder portions.

21. The printing apparatus defined in claim 20 and further including color densitomiter means for sensing colors in the printed matter printed by the printing apparatus, means for comparing the densitomiter means readings with the dot count for each print station to produce a color correction signal and means for applying said correction signal to said control means to readjust the number of dots to be printed by that station on said third cylinder portions.

22. The printing apparatus defined in claim 18 and further including means on said first cylinder for releasably gripping the leading edge of a sheet, the number of gripping means being equal to the number of times that said first cylinder diameter is longer than the plate cylinder diameter and each gripping means being movable between gripping and releasing positions.

23. The printing apparatus defined in claim 18 and further including imaging means responsive to image signals and positioned opposite each third cylinder for applying images thereto and control means for applying image signals to each said imaging means, said control means including a computerized work station for receiving and processing picture signals to develop said image signals.

24. Printing apparatus comprising

a machine frame;

an impression cylinder rotatably mounted to the frame;

at least one print station positioned opposite the impression cylinder, each print station including a blanket cylinder rotatably mounted to the frame for rolling contact with the impression cylinder, a plate cylinder rotatably mounted to the frame for rolling contact with the blanket cylinder and means for applying image dots to a plate supported by the plate cylinder;

means for rotating said cylinders in unison;

means for applying ink to said plate;

ink regulating means responsive to ink control signals for regulating the amount of ink applied to the plate by the ink applying means at each print station; and

control means responsive to picture signals for actuating the image applying means at each print station to form on said plate a corresponding image comprised of dots, said control means counting the number of image dots to be formed by each print station on selected portions of said plate and controlling the ink regulating means for that print station based on the number of dots to be printed by that print station on said plate portions.

25. The printing apparatus defined in claim 24 and further including color densitomiter means for sensing colors in the printed matter printed by the printing apparatus, means for comparing the densitomiter means readings with the dot count for each print station to produce a color correction signal and means for applying said correction signal to said control means to readjust the number of dots to be printed by that station on said plate portions.

26. Printing apparatus comprising

a machine frame;

an impression cylinder rotatably mounted to the frame;

at least one print station positioned opposite the impression cylinder, each print station including equal diameter plate and blanket cylinders, rotatably mounted to said frame parallel to the impression cylinder and means for imaging a plate supported on the plate cylinder, said cylinders having correspondingly sized coaxial meshing gears for rotating said cylinders in unison, said impression cylinder gear being composed of a number of arcuate segments corresponding to the number of print stations, the arcuate length of each gear segment being equal to the circumferences of said plate and blanket cylinder; and

means for rotating said cylinders.

27. Printing apparatus comprising

a machine frame;

an impression cylinder rotatably mounted to the frame;

at least one print station positioned opposite the impression cylinder, each print station including equal diameter plate and blanket cylinders rotatably mounted to said frame parallel to the impression cylinder and means for imaging a plate supported on the plate cylinder, said cylinders having correspondingly sized coaxial meshing gears for rotating said cylinders in unison, said impression cylinder gear being composed of a number of arcuate segments corresponding to the number of print stations, the arcuate length of each gear segment being equal to the circumferences of said plate and blanket cylinder gears and said gear segments having corresponding teeth with substantially identical tooth profiles those teeth having been cut in parallel simultaneously by the same gear cutting tool; and

means for rotating said cylinders.

28. Printing apparatus comprising

a machine frame;

an impression cylinder rotatably mounted to the frame;

at least one print station positioned opposite the impression cylinder, each print station including equal diameter plate and blanket cylinders rotatably mounted to said frame parallel to the impression cylinder and means for imaging a plate supported on the plate cylinder, said cylinders having correspondingly sized coaxial meshing gears for rotating said cylinders in unison, said impression cylinder gear being composed of a number of arcuate segements corresponding to the number of print stations, the corresponding teeth of said gear segments having substantially identical tooth profiles having been cut in parallel simultaneously by the same gear cutting tool.

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United States Patent [19]

Bird

[11] **Patent Number: 4,939,992**

[45] **Date of Patent: * Jul. 10, 1990**

[54] **FLEXOGRAPHIC COATING AND/OR PRINTING METHOD AND APPARATUS INCLUDING INTERSTATION DRIERS**

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[*] Notice: The portion of the term of this patent subsequent to Jun. 27, 2006 has been disclaimed.

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[52] U.S. Cl. 101/183; 101/424.1; 101/488; 101/211; 118/46

[58] Field of Search .... 101/115, 488, 424.1, 101/183, 138, 136, 177, 181; 118/46, 66, 58; 427/378, 379, 382; 34/1 SS

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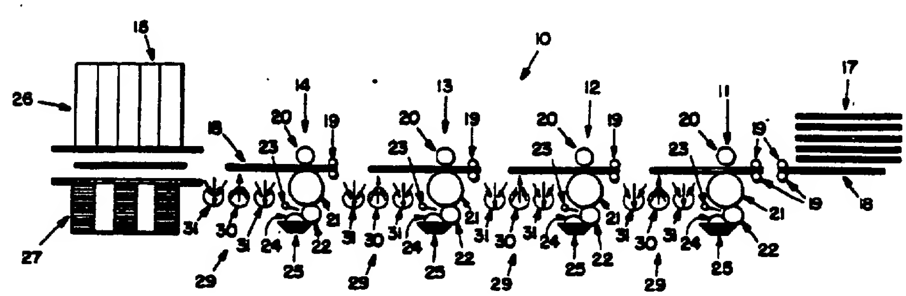
Primary Examiner—Clifford D. Crowder
Attorney, Agent, or Firm—Perman & Green

[57] **ABSTRACT**

A straight line flexographic printing method and machine having a plurality of in-line liquid application stations, at least one of which is an upstream ink image-printing stations for printing ink images on a succession of cardboard copy sheets, and at least one of which is a final downstream liquid-application station which may be a coating application station for printing a protective, and/or aesthetic coating over selected portions of, or over the entire ink image-printed surface of each cardboard copy sheet. The present method and apparatus involves the placement of a forced hot air drying station between each of the liquid application stations to evaporate volatile solvent/diluent from the ink images applied at each inking or coating station before the application of additional ink images or coatings thereover at the next downstream liquid application station.

11 Claims, 1 Drawing Sheet



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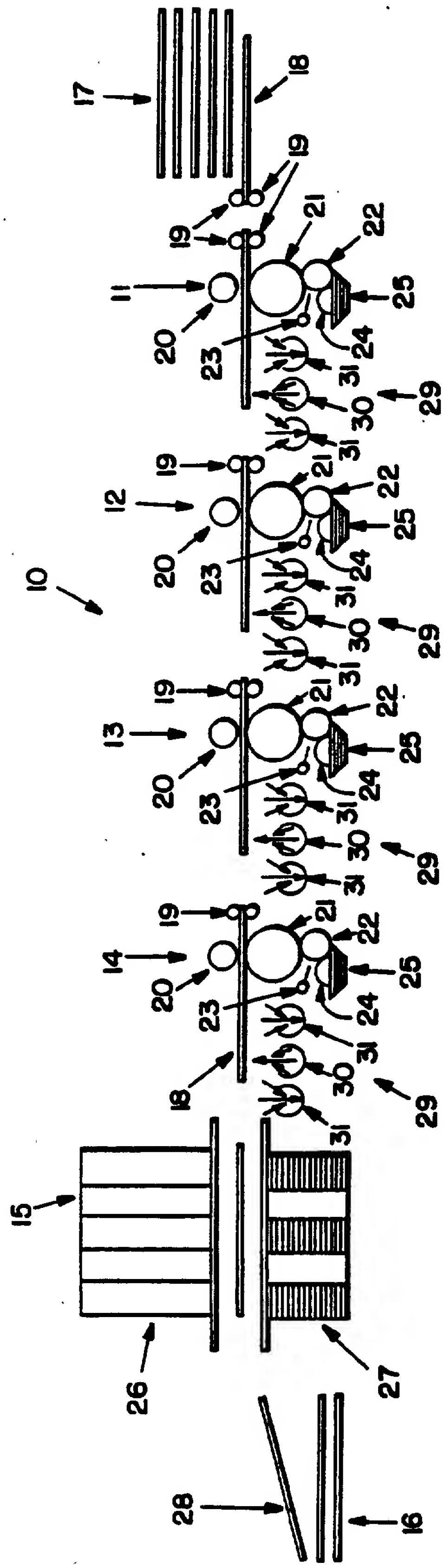

FIG. 1.

FLEXOGRAPHIC COATING AND/OR PRINTING METHOD AND APPARATUS INCLUDING INTERSTATION DRIERS

BACKGROUND OF THE INVENTION

The present application is a continuation-in-part of application Ser. No. 65,914 filed June 24, 1987, now U.S. Pat. No. 4,841,903.

Conventional flexographic coating and/or printing machines or presses comprise one or more image-printing stations each having a plate cylinder to which is fastened a flexographic plate having raised image or printing areas. Aqueous or solvent ink is applied to the raised image areas, which ink is transferred directly to an absorbent copy sheet or web.

This differs from lithographic printing in which the flat, imaged surface of a plate is continuously wetted with aqueous damping solution, which adheres only to the background areas, and the plate is then inked with oleoresinous ink composition which adheres only to the image areas of the plate as wet ink. The ink is offset-transferred to the rubber surface of a contacting blanket cylinder, and retransferred to the receptive surface of a copy web or a succession of copy sheets, such as of paper, where the ink gradually hardens or cures by oxidation, in some cases after passing through a final drying station located downstream of the final liquid application station where the volatile solvent is evaporated from the ink composition of the images.

In multicolor printing processes and machines of both flexographic and lithographic types, the copy web or sheets pass through a plurality of ink-printing stations in which inks of different colors are printed over the same areas in partial or complete registration to produce multi-ink images or image portions having a variety of desired colors or color-blends. However such multi-ink images vary in sharpness, color-intensity and tone or hue depending upon the number of underlying ink portions.

Stiff, heavyweight cardboard sheets, such as corrugated cardboard, can only be printed and/or coated on a straight line flexographic printer and/or coater since such sheets cannot be caused to wrap around and over plate cylinders or impression cylinders, as is common with lithographic presses and with some known flexographic presses which are used for printing flexible sheets.

Flexographic straight-line printing machines are employed for the printing of relatively thick sheets of highly absorbent material, such as corrugated cardboard, which are moved in a straight line, in flat condition, through one or more ink-printing stations. At each such station the thick absorbent sheets pass in the nip between a flexographic plate cylinder and an impression or back-up cylinder, the raised images on the plate applying flexographic ink directly to the absorbent surface of each sheet, such as cardboard. The flexographic ink comprises resin, pigment and volatile diluents and/or solvent and dries by the absorption of the diluent/solvent into the absorbent surface. This results in some spreading of the printed images, lines, etc., with resultant loss of sharpness, detail and quality of print. This is particularly true where different colored inks are printed in partial or complete registration, which further causes variations in coloration or color tone between areas which are overprinted and areas which are not, e.g., the redness of a red line printed over a grey underprint is visibly different from the redness of the same line extending onto unprinted areas of the sheet, due to variations in the ability of the sheet to quickly absorb the diluent/solvent. The same is true with respect to the lack of uniformity of surface appearance of a solvent-applied overcoating.

In cases where cost is not a factor and/or where the aesthetic advantages of a protective supercoating, generally referred to as a coating in the flexographic industry, are desired, it is known to provide the printing machine with a downstream coating station having a coating application unit for the application of an overall protective coating over the entire printed area of the copy sheets.

While the in-line application of a protective or aesthetic coating over the flexographic images on a succession of copy sheets will improve the appearance of the print and render it smear-resistant and weather-resistant, the relatively wet condition of the printing ink composition, particularly in overprinted areas, at the time that the coating composition is applied thereover, produces a visible change in the appearance of the portions of the coating overlying the printed images during the evaporation and/or absorption of the solvent, diluent, water, etc., whereby, for example, a glossy-surfaced protective coating acquires a non-uniform flat, matte, or non-glossy surface, particularly in areas overlying the multi-printed images, and even the affected areas are not uniform in appearance depending upon the colors and/or surface areas of the underlying printed images due to the solvent/diluent in the coating interacting with the still-wet color inks. For example, printed colored images, half-tone illustrations, and the like, which are intended to be emphasized or heightened in appearance, by the application of glossy coatings thereover, undergo loss or degradation in the uniformity of their appearance and their color during the drying of the coating.

These defects in color quality and coating appearance are of substantial importance in cases where the additional expense of one or more coatings is justified by the desired results, i.e., promotional displays, artwork, product containers, etc. The defects, i.e., uneven surface appearance of the coating(s) and the quality of the underlying color images, detract from the appearance of the coating and/or underlying images, particularly in the case of multi-colored images and are due to the presence of various amounts of residual volatile solvents, diluents, water, etc., within the flexographic inks of the first images at the time that the second flexographic images are applied thereover, and/or to the presence of volatile solvents, diluents or water within the second subsequent flexographic ink images at the time that the coating is applied thereover. The application of a top coating over the printed images retards the volatile solvent, diluent or water against escape in the final drying station, but the volatiles can eventually migrate from the cardboard into the top coating during the final drying of the printed cardboard, resulting in a loss of perfection in the surface finish of the top coating.

These problems have not been important in cases where the sheets being printed are cardboard shipping cartons or the like, where high quality is not considered important. However in some cases, such as with display cardboard and ultimate sale cardboard containers, such as shoe boxes, toy boxes, clothing closets, etc., where high quality, multi-color printing is important, it has

been necessary to print an outer paper sheet by means of higher quality printing processes and then adhere or laminate the printed sheet to the cardboard support. This is expensive and labor-intensive. The present invention makes this unnecessary for many flexographic applications.

It is known to provide one or more drying stations between inking stations on continuous web flexographic printing machines. However such machines convey the copy sheet through a tortuous path and thus are only useful for printing flexible webs and not sheet lengths or cardboard blanks.

It is an object of the present invention to provide a novel flexographic printing and/or coating method and apparatus for the in-line application of one or more inks and/or protective or aesthetic coatings over imaged subject matter flexographically printed onto each of a succession of heavyweight, absorbent copy sheets while avoiding the usual degradation of sharpness, detail, color uniformity or loss of uniformity of the surface appearance of areas of the ink(s) and/or coating applied over the previously ink-printed images.

It is another objective of the present invention to provide a flexographic printing method and apparatus for providing high quality flexographic printing directly on heavyweight sheets, such as corrugated cardboard, thereby avoiding the need for pre-printing paper, such as by offset lithographic means, and thereafter adhering it to a cardboard support.

Essentially, the present invention is concerned with providing high quality flexographic copies of the types desired, directly on heavyweight absorbent sheets particularly in cases where the additional expense of multiple colors and supercoatings is justified by the desired results.

SUMMARY OF THE INVENTION

The present flexographic method and apparatus provides for the inline forced hot air drying of flexographic ink images, including multicolor images and photographic reproductions, printed or applied at one liquid application station before the application of a second printing ink or a continuous or spot coating over said ink images at the next downstream liquid application station by interposing an in-line drying station between each of said liquid application stations in order to predry the first colored ink images prior to the application of images of a second color or a final coating thereover, whereby the drying of each ink removes volatile solvents/diluents which can cause the ink images to spread or broaden, and/or blemish the next ink or coating applied thereover.

The evaporation of volatile solvents/diluents from flexographic ink images applied to stiff, absorbent sheets is unknown and unobvious since such images are intended to dry by absorption of the volatile solvents/diluents and oil of the ink into the absorbent paper sheet, such as the outer paper ply of a corrugated cardboard. However I have discovered that the interstation evaporation of such volatiles dries the ink images before they can spread, bleed or wick into the absorbent paper support, thus preserving their sharpness, detail and coloration. Moreover such evaporation dries the surfaces of the first printed images so that they are more receptive to second images or coatings applied thereover and more resistant to being diluted, spread and/or broadened by the volatiles present in the second applied images or coating. Moreover the pre-removal of the volatile avoids the accumulation of volatiles, in different quantities, in different areas of the printed copy sheets or cardboard sheets, depending upon the number of overprints, the presence of which can continue to cause the images to spread or broaden and/or can result in color degradation and degradation in the uniformity of the appearance of an overcoating, if present.

The present invention is concerned with drying or solvent/diluent evaporation prior to the application of a second ink or a supercoating over the printed images.

The coating compositions conventionally used to apply protective or aesthetic coatings over printed images are aqueous solutions, dispersions or emulsions of water-dispersible or water-soluble film-forming binder materials, such as acrylic resins, hydrophilic colloids, vinyl alcohol, etc. Also, coating compositions free of volatile solvents or vehicles are commonly used, such as resin precursor compositions which are polymerizable or curable by exposure to ultraviolet or other radiation. Such compositions are based upon liquid acrylic monomers or pre-polymers, or photopolymers and photoinitiators, cross-linking agents and/or other conventional ingredients. Both solvent-applied and solvent-free coating compositions can produce microporous coatings which are permeable to volatiles. While they are permeable to volatile ink solvents, diluents and water, the escape of these volatiles mars the appearance of the surface finish of the coatings, as discussed supra.

Multicolor flexographic printed ink images commonly are formed by using inks containing pigments of different primary colors which, when combined in superposition, produce different secondary colors depending upon the identity and number of primary colors used. However, unless each ink image is dried sufficiently to evaporate the solvents and water present therein, before a second ink is printed in partial or full registration thereover, said solvents and water produce blemishes in the total image when they are eventually evaporated. Such blemishes include voids uneven tones, ragged edges, etc.

Another problem, pertinent to the embodiment of drying between printing stations, relates to the reduced receptivity of wet images for images and/or supercoatings applied thereover, producing uneven, discontinuous or spotty images or supercoatings having "holidays" or areas which have not accepted the images or supercoating.

The novel flexographic method and apparatus of the present invention overcomes these problems with stiff, heavyweight absorbent sheets by drying the ink-imaged copy sheets prior to the application of additional ink images and/or prior to the application of a coating over the ink-printed images, whereby substantially-perfect flexographic images and/or coatings having excellent uniformity, color tone and surface properties, such as gloss, are produced on stiff copy sheets, such as cardboard, printed and/or coated in a straight line flexographic apparatus.

THE DRAWING

FIG. 1 is a vertical cross-sectional view of a flexographic printing and punching machine, illustrating four liquid application stations and the interposition of inline drying stations between each of the liquid application stations and including a final downstream in-line drying station in advance of an optional die cutting, folding and/or gluing creasing station.

DETAILED DESCRIPTION

Referring to the drawing, FIG. 1 illustrates a flexographic printing machine 10 comprising four liquid application stations 11, 12, 13 and 14 the final downstream station 14 being a coating station, if desired, an an optional die cutting, creasing, folding and/or gluing station 15 at which the printed cardboard copies are die cut into desired shapes, such as carton blanks, and creased for folding purposes, if desired, prior to stacking at 16.

As illustrated, the present apparatus includes a feeding station 17 for feeding a continuous supply of cardboard blanks or sheets 18 in a straight line between a plurality of feed rolls 19 into and through each of the liquid application stations 11 to 14 in which each sheet 18 is engaged between an upper impression cylinder 20 and a lower printing cylinder 21. The printed blanks 18 are finally fed to a cutting and creasing press station 15 in which they are die cut and creased, and moved to a stack 16.

Each of the flexographic printing stations 11 to 14 comprises a flexographic plate cylinder 21, the final downstream one of which, in station 14, can be one for printing an overall or spot coating over the portions of the sheet 18 printed with ink images in stations 11, 12 and 13. The liquid application systems in stations 11 to 14 each comprise the plate cylinder 21, a metering roll 22 with associated doctor blade 23, an application roll 24 and an ink (or coating) supply 25. The illustrated ink (or coating) supply 25 is a pan into which the roll 24 extends to receive a continuous supply of the ink or coating composition as it is rotated in the counter-clockwise direction. However most commercially available flexographic printing machines pump the ink or coating supply as a continuous supply onto the surface of the applicator roll 24. The doctor blade 23 is adjustable relative to the surface of the metering roll 22 in order to control the thickness of the ink or coating layer moved onto the plate surface on the plate cylinder 21 for transfer to the undersurface of each cardboard sheet 18.

The apparatus includes conventional registration means, including feed rolls 19, so that each sheet 18 and the plate on each printing cylinder 21 are in exact registration to precisely control the areas of each sheet 18 to be printed with different colored inks at stations 11 to 14 or to be printed with coating composition at station 14.

The multi-printed sheets 18 are moved into the optional station 15, which includes a movable cutter/-crease die 26 and an anvil 27, in order to cut away and/or crease predetermined portions thereof to form printed blanks 28 which are stacked at 16.

The essential novelty of the present flexographic printing apparatus resides in the plurality of interstation driers 29, one or more of which are located after each of the printing stations 11 to 14 for purposes of rapidly drying the ink images applied to sheets 18 at each printing station 11 to 13 before the printed sheets enter the next printing station and to dry the final ink or coating after print station 14. This has been found to result in substantially sharper, clearer images being produced on the cardboard sheets as compared to conventional straight line flexographic printers which permit the images to dry by absorption of the volatile ink solvent-/diluent into the cardboard surface. Moreover the present apparatus has been found to permit the overprinting of different colored inks in partial or complete registration without dilution or spreading or alteration of the sharpness or color tone of the underlying images. The pre-drying of the underlying images sets their color and sharpness, preventing them from being spread and diluted by absorption by the cardboard sheet. Moreover the pre-drying of the images renders them more resistant to being redissolved and spread or diluted by the volatile solvent/diluent of the next-applied ink, and provides a pre-dried ink surface which is more receptive to being overprinted with the next-applied ink and is resistant to being drawn back off the cardboard surface by the pressure of the next ink printing cylinder 21.

Referring to FIG. 1, each interstation drier 29 comprises at least one elongate tubular forced hot air knife 30 which is closely-spaced from the printed undersurface of the sheets 18, and an associated pair of elongate tubular vapor suction means 31 for withdrawing the evaporated ink vehicle or solvent to a recovery unit or for safe release to the outside atmosphere.

In operation, the inked plate on the first flexographic cylinder 21 is rotated against the ink-receptive surface of each cardboard sheet 18, to which the wet flexographic ink images are transferred to form an image-printed copy sheet 18. Each sheet 18 is conveyed, imaged face down, through a first drying interstation 29, comprising at least one forced hot air knife 30 and a spaced pair of vapor-extraction units 31 which withdraw and convey the volatile vehicle vapors to a recovery unit, to the atmosphere or for other safe disposal.

As illustrated, each printed copy sheet 18 is conveyed past the first air knife 30 to form a dried printed copy sheet which is moved into the next liquid application station 12.

The air knife 30 and the extraction units 31 are conventional elements normally used as final drying elements on printing and coating machines of different types, and are sufficiently small in diameter, i.e., about two inches, that they can be accommodated within the small areas present between printing stations on conventional straight-line flexographic printing machines. Knives 30 are elongate tubular elements provided with an elongate narrow slot formed by opposed, converging walls. Heated air is circulated through the tubular elements under pressure and is expelled from the elongate slot as a concentrated narrow band of high speed hot air which is directed against the undersurface of the ink-printed copy sheets 18 to evaporate the volatile solvent or vehicle therefrom to release vapor which is withdrawn through elongate slots in the extraction units 31. Substantial drying is produced by the each air knife 30, but a spaced second air knife may be included at each drying station 29 to insure complete drying prior to the entry of the copy sheets 18 to the next liquid application station.

In the apparatus of FIG. 1, the second ink application station 12 is another ink printing station, such as for printing ink of a second color. Thus the various elements of station 12 are numbered similarly to those of station 11.

The printed copy sheets 18 exiting the second printing station 12 are moved by feed rollers 19, printed side down, through the second drying interstation 29 which is similar to the first drying station and comprises a similar elongate air knife 30 and a similar spaced pair of extraction units 31.

The line of forced hot air from the second knife 30, across the width of the copy sheets printed in station 12, substantially dries the second-applied ink images by evaporating the vehicle therefrom, after which the

dried, copy sheets 18 are conveyed by downstream feed rollers 19 for entry of the twice printed copy sheets 18 into the next printing station 13 where ink images of a third color are printed over the pre-applied, pre-dried ink images, and are dried at the next downstream inter-station drier 29 prior to entry into the final printing station 14. The final downstream station 14 can, if desired, be a coating application station which is similar to the inking stations 11 to 13 with respect to flexographic plate cylinder 20 and its associated rollers, except that the plate has an overall or spot coating surface, and coating composition rather than ink is fed thereto from supply 25.

Thus, the station 14 can be a coating station for the application of continuous spot coatings onto the pre-dried printed copy sheets 18 which are transported by feed rollers 19 past a final downstream drying station 29 and its air knife 30 to evaporate the water or other volatile solvent/diluent from the coating and form final copies 18 which are cut, creased, folded and/or glued and stacked.

In operation, a succession of cardboard copy sheets 18 is automatically moved in a straight line by feed roller 19 and transported through two or more ink printing stations into printing contact with two or more flexographic cylinders 21 to print images, such as of different colors, on predetermined similar and/or different areas of the underside of each copy sheet, using conventional aqueous flexographic inks containing volatile organic solvents(s) and water At each ink-printing station 11 to 14 a flexographic printing plate is fastened to a plate cylinder 21 and inked by means of metering roller 22. The ink is selectively received by the image areas of the plate and transferred to the under-surface of a copy sheet 18 passed in the nip of cylinder 21 and impression cylinder 20. At this point, the ink images on each imaged copy sheet 18 still contain the volatile organic solvent and water. Rather than moving the inked copy sheets 18 directly from the first ink printing station to the next ink printing station 12, as is conventional in the art, the present method and apparatus provides for intermediate or interstation drying of the inked copies to evaporate the volatile organic solvent from the ink images and copy sheet to form solvent-free copies 18 prior to the application of new ink images thereover.

Flexographic processes are conventionally used to print ink images onto absorbent paperboard, drying of the ink images being caused by the absorption of the volatile ink vehicle into the copy sheet. Heretofore it has not been possible to apply high quality multicolor ink images onto cardboard in a single pass on straight line flexographic machines because the volatile solvent-/diluent of the after-applied ink images redissolves and smears the first applied images which mask the absorbent copy sheet against rapid absorption of the after-applied solvent. The same problem occurs when solvent/diluent-applied coating compositions are applied over ink images in the flexographic process.

The present invention solves these problems by providing the interstation forced hot air driers between each of the liquid application stations on a straight line flexographic printing and/or coating apparatus, whereby the volatile solvents and water are evaporated to dry the ink images rapidly before additional images or coatings are printed thereover. Rapid evaporation drying renders the dry ink images resistant to being dissolved or smeared, and reduces the dwell time of the after applied solvents. Conventional drying by absorption is very slow, does not remove the solvents, diluents or water from the copy sheets and retards drying in cases where the later applied composition is applied over pre-printed areas of the absorbent copy sheet.

Thus the present flexographic printing process makes it possible to print stiff cardboard copy sheets, even those which have little or no porosity and little or no absorbing ability, such as cardboard having a printing face of high quality non-absorbant paper or plastic-coated cardboard, corrugated plastic board, and other similar materials on which quality images could not be printed by conventional flexographic printing processes.

It is to be understood that the above described embodiments of the invention are illustrative only and that modifications throughout may occur to those skilled in the art. Accordingly, this invention is not to be regarded as limited to the embodiments disclosed herein, but it to be limited as defined by the appended claims.

What is claimed is:

1. In a flexographic, straight line printing machine comprising a plurality of liquid application stations each comprising a printing cylinder, at least one of which is an upstream ink printing station for the printing of ink images containing a volatile solvent/diluent onto a succession of individual cardboard copy sheets as such sheets are moved therethrough, and at least one of which is a downstream printing station , and means for continuously feeding said individual copy sheets, without bending, through said liquid application stations, the improvement which comprises an intermediate drying station comprising at least one forced hot air means positioned between each of said liquid application stations to apply a line of forced hot air across the direction of travel of said sheets as they move therepast to effect the evaporation of the solvent/diluent from the ink images printed on said cardboard copy sheets prior to the movement of the ink-imaged copy sheets into the next liquid application station, to effect the drying of said images prior to the application of the rink images or a coating thereover.

2. A flexographic, straight line printing machine according to claim 1 in which one or more of the downstream application stations comprise coating stations for the application of spot coatings or continuous coatings, to said copy sheets.

3. A flexographic, straight line printing machine according to claim 1 in which each said intermediate drying station also comprises a vapor extraction means.

4. A flexographic straight line printing machine according to claim 1 which further comprises a final station for cutting the printed cardboard copy sheets.

5. A flexographic, straight-line printing machine according to claim 1 comprising at least two adjacent ink printing stations for printing ink images of different colors in partial or complete registration on said cardboard copy sheets.

6. A method for the flexographic printing of a succession of cardboard copy sheets on a continuous straight line, flexographic printing machine which comprises the steps of continuously feeding a succession of individual cardboard copy sheets, without bending, through a plurality of liquid application stations, each having a printing cylinder, including at least one upstream ink printing station and one or more downstream stations, printing images comprising volatile solvent-/diluent-containing ink onto said copy sheets as they

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move through each of said ink-printing stations to form imaged copy sheets, heating said imaged sheets after each ink-printing station by moving them past forced hot air which applies a line of forced hot air across the direction of travel of said sheets to substantially-completely evaporate the volatile solvent/diluent therefrom to form dry imaged copy sheets, prior to movement thereof into the next liquid application station.

7. A method according to claim 6 in which one of said downstream printing stations comprises a coating station in which a coating is applied which covers the dry images printed at the ink printing stations.

8. A method according to claim 7 in which a said coating is applied comprising a partial or spot coating which overlies only a portion of the dry images printed at the ink printing stations.

9. A method according to claim 6 in which drying is accomplished by directing a narrow line of forced hot said air from air knives against said imaged copy sheets.

10. A method according to claim 6 in which the evaporated solvent/diluent is extracted from the area at which it is evaporated.

11. A method according to claim 6 which comprises printing ink images of different colors in partial or complete registration at at least two adjacent ink printing stations.

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United States Patent [19]

Douglas

[11] **Patent Number: 4,977,828**

[45] **Date of Patent: Dec. 18, 1990**

[54] **TRANSFER ROLLER DEVICE FOR PRINTING PRESSES**

[75] Inventor: **David D. Douglas**, Garland, Tex.

[73] Assignee: **Printing Research, Inc.,** Dallas, Tex.

[21] Appl. No.: **390,379**

[22] Filed: **Aug. 7, 1989**

[51] **Int. Cl.**[5] **B41F 9/00**

[52] **U.S. Cl.** **101/142;** 101/420; 29/132; 271/204

[58] **Field of Search** 101/142, 416.1, 417, 101/422; 29/123, 129.5, 131, 132; 271/204, 82

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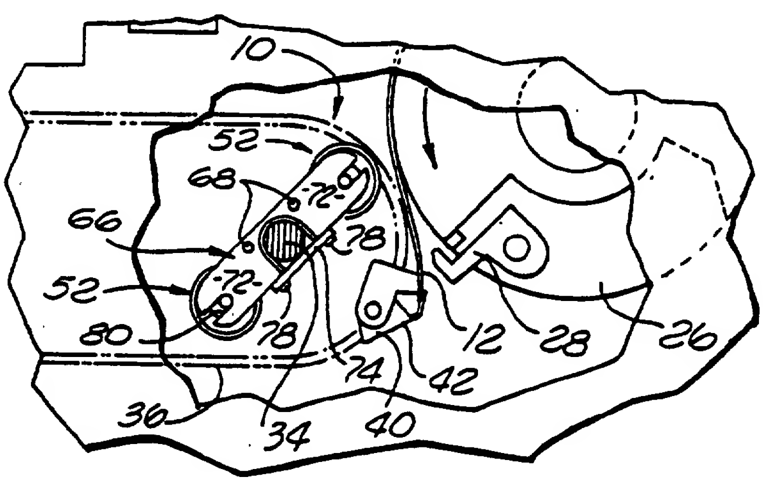
Primary Examiner—Eugene H. Eickholt

Attorney, Agent, or Firm—Kelly, Bauersfeld & Lowrey

[57] **ABSTRACT**

A roller transfer device for use in sheet fed rotary printing presses of the type employing a one and one half to one delivery system, the transfer device comprising a frame mounted to a drive shaft adjacent the press impression cylinder, and supporting diametrically disposed fabric covered rollers arranged to engage and support a printed sheet during transfer from the impression cylinder to a further processing station within the press.

23 Claims, 3 Drawing Sheets



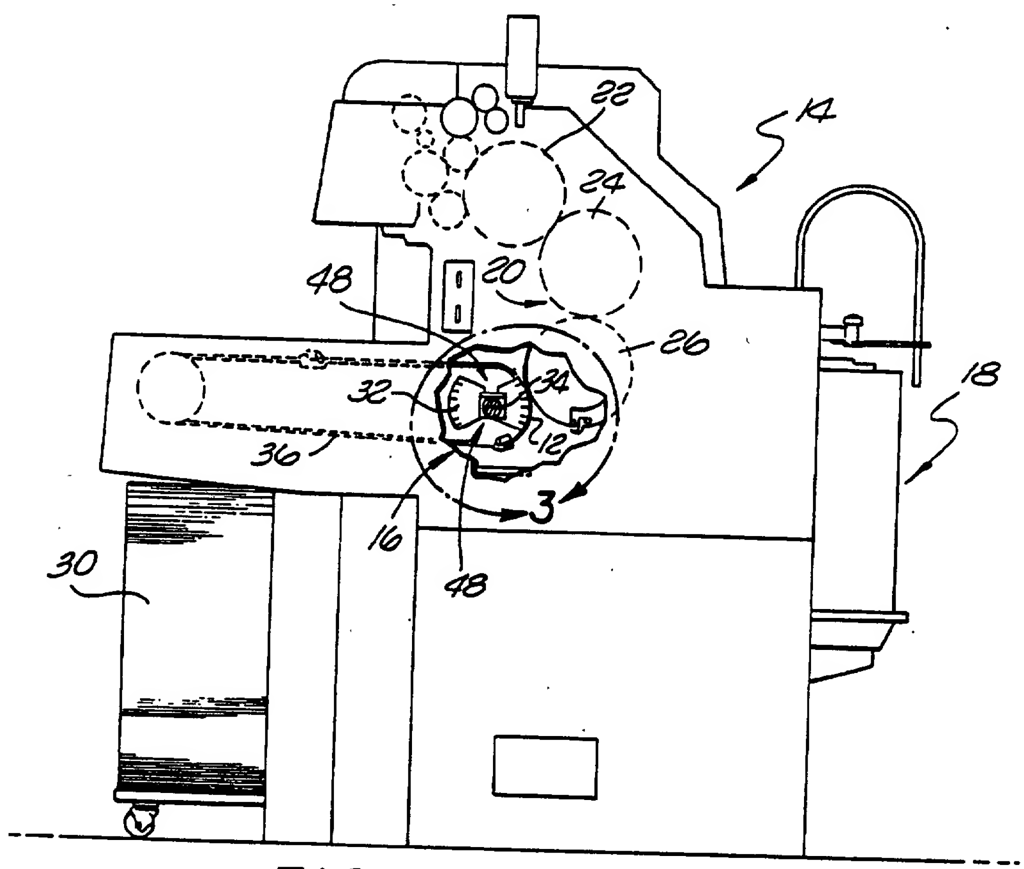


FIG. 1 PRIOR ART

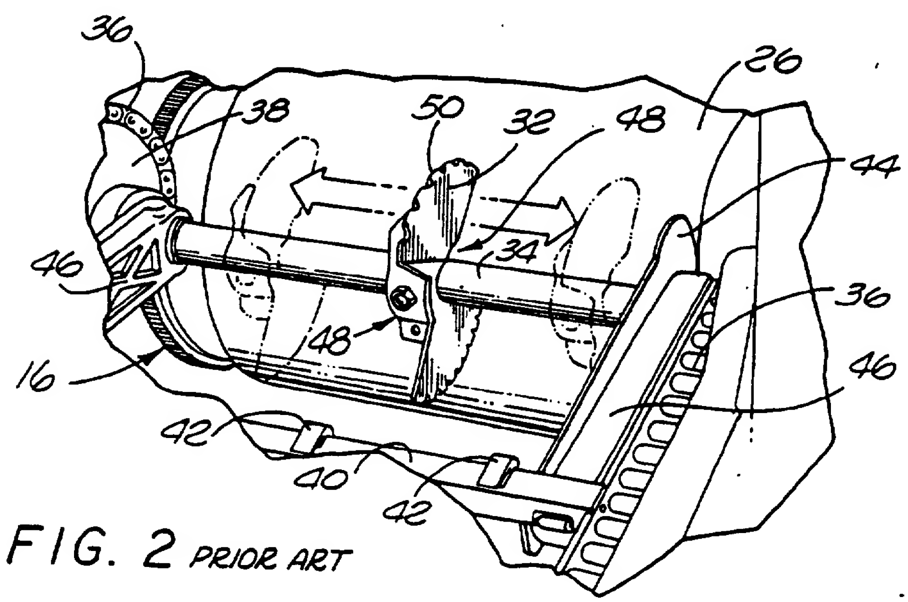
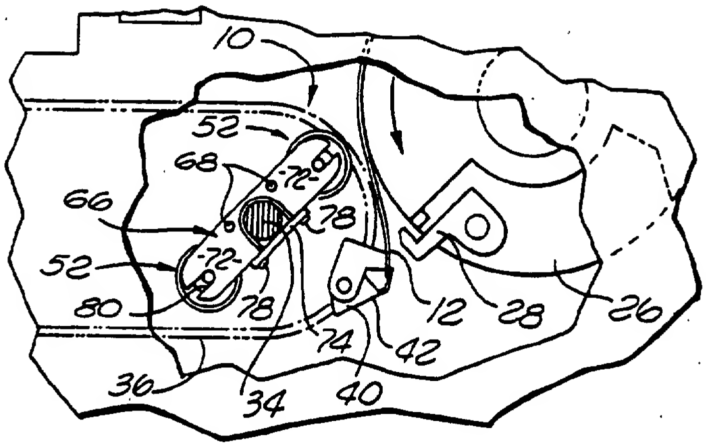


FIG. 2 PRIOR ART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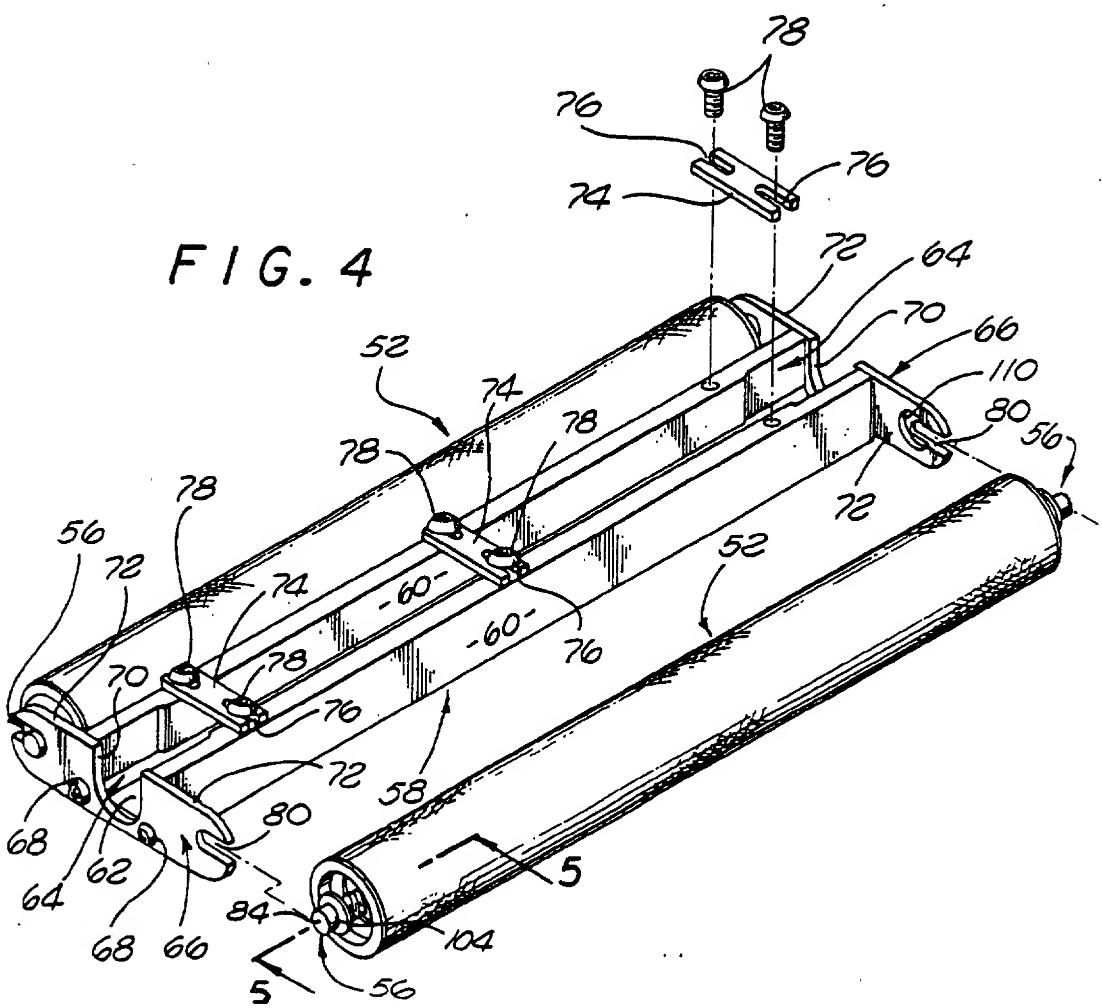
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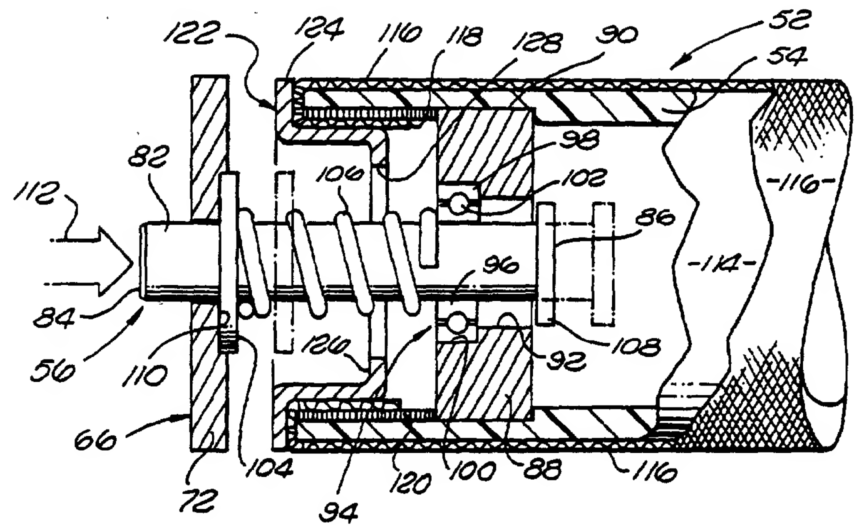
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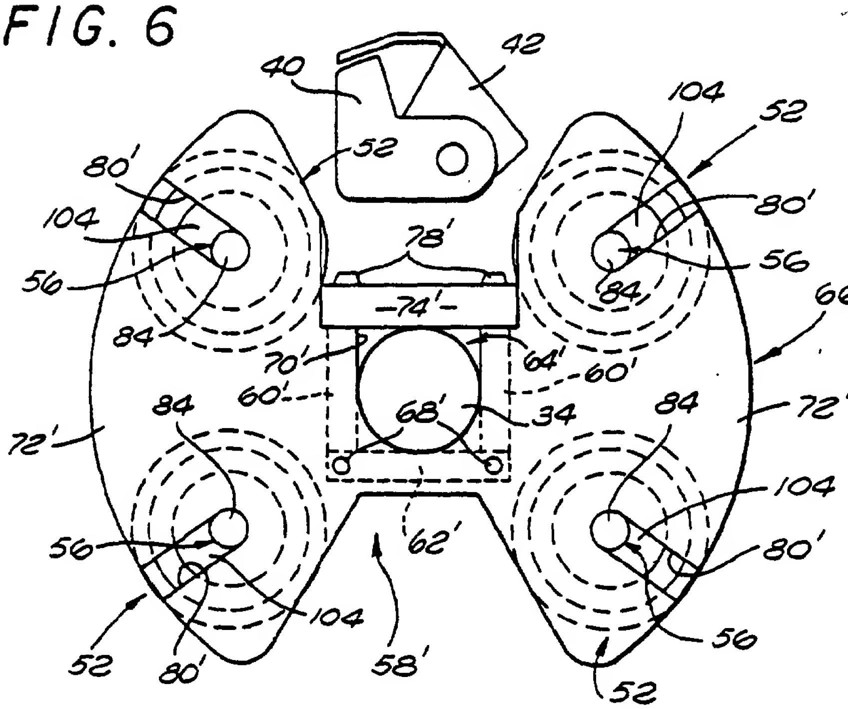
FIG. 5

FIG. 6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TRANSFER ROLLER DEVICE FOR PRINTING PRESSES

BACKGROUND OF THE INVENTION

This invention relates to sheet fed, off-set rotary printing presses of the type having a one and one half to one delivery system, and more particularly to a new and improved transfer device for use in the delivery system of such presses.

In a sheet fed, off-set rotary printing press, it is necessary that the wet ink side of a freshly printed sheet be supported during transfer of the sheet from the press impression cylinder to either a press delivery station or to another printing station within the press. To effect the transfer from the impression cylinder, most off-set printing presses employ a delivery system which includes a chain conveyor carrying a gripper bar assembly having sheet grippers which grip the leading edge of the sheet and pull the sheet from the impression cylinder around a transfer device which typically includes skeleton wheels, drums, cylinders or other support members depending upon the type of press involved, which support the wet ink side of the sheet during the transfer.

With rotary presses having a one to one delivery system where the transfer device rotates one complete revolution during each passage of a gripper bar assembly, it has been found that a delivery system using the inventions described in U.S. Pat. Nos. 3,791,644 and 4,402,267 issued, respectively Feb. 12, 1974 and Sept. 6, 1983, to Howard W. DeMoore, can be reliably and effectively used to support the wet ink side of the printed sheet with out marking or marring the sheet. The inventions described in the foregoing DeMoore patents have received wide acceptance in the printing industry and have achieved very substantial commercial success, and transfer and delivery systems embodying those inventions are currently being manufactured and sold under license by Printing Research, Inc. of Dallas, Texas, the assignee of the present invention. Each of the foregoing patents, the disclosure of which are hereby incorporated herein by this reference, employs a wheel or drum formed as a cylinder having a cylindrical sheet support surface which is discontinuous and formed with a single longitudinally extending opening to permit the gripper bar assembly to pass around the wheel or drum adjacent the impression cylinder.

Prior to the present invention, it was not thought possible to use a wheel or drum type device such as disclosed in the above identified DeMoore patents in a rotary press employing a one and one half to one delivery system, since the transfer wheel or drum must rotate one and one half complete revolutions for each passage of a gripper bar assembly, and to provide two longitudinal openings along the drum of a size sufficient to permit the gripper bar assembly to pass through the nip between the impression cylinder and the transfer device would reduce the effective support surface of the transfer device below that required for effective sheet support without marking. Accordingly, prior to the present invention rotary presses using a one and one half to one delivery system have typically used skeleton wheels of the general types referred to as prior art in the DeMoore U.S. Pat. No. 3,791,644. Such prior art skeleton wheels typically comprise thin disc shaped wheels having a fluted or serrated rim designed to provide minimum surface area contact with the wet inked surface of the freshly printed sheet, and which typically are adjusted along their drive shaft so as to engage the sheet in an area where minimum wet ink is present. In a press having a one and one half to one delivery system, the prior art skeleton wheels are segmented so as to form two openings between rim segments to permit the gripper bar assemblies to pass around the wheel adjacent the impression cylinder.

One problem inherent in the use of prior art skeleton wheels in a one and one half to one delivery system is that the press must be stopped and the position of the skeleton wheel adjusted for each new print job being run. Further, unless the prior art skeleton wheels can be located to engage the sheet only where no wet ink is present, for example in the margins of a page, the rim of the skeleton wheel may mark or mar the printed sheet and leave "tracks" and indentations on the printed sheet.

Another problem which has been encountered with the delivery system of such a press is that the effective diameter and speed of rotation of the transfer device must be the same as those of the impression cylinder so that there will be no relative motion between the sheet leaving the impression cylinder and engaging the support surface of the transfer device. In presses having a one and one half to one delivery system, the transfer device is typically chain driven, and it is extremely difficult, if not impossible to maintain the rotational speed of the transfer device equal to that of the impression cylinder. As a result, it has been found that relative motion between the sheet and the support surface of the transfer device has caused marking and marring of the wet ink surface of the sheet.

Thus, there exists a need for a new and improved transfer device for use with the transfer or delivery system of a press having a one and one half to one delivery system which will permit the prior art skeleton wheels used with such presses to be replaced with a wheel or drum type system which can take advantage of the inventions disclosed in the above mentioned DeMoore patents so as to substantially prevent marking and marring of the printed sheet. As will become more apparent from the following, the present invention solves this need in a new and unobvious way.

SUMMARY OF THE INVENTION

The present invention provides a new and improved transfer device for use in the delivery system of a sheet fed, off-set rotary printing press of the type employing a one and one half to one delivery system for conveying freshly printed sheets from the impression cylinder to a further processing station within the press without marking or marring the wet ink. The present invention employs fabric covered rollers mounted for free rotation on a frame to a drive shaft and which can be used without requiring any press modification to replace prior art skeleton wheels in the delivery system of substantially any printing press having a one and one half to one delivery system.

The rollers are formed as continuous cylindrical shells having a friction reducing coating thereon and covered by a fabric material impregnated with a liquid repellant substance. The rollers are mounted to the frame for easy removal, and are spaced apart to permit the gripper bar assembly of the press delivery system to pass between the rollers adjacent the impression cylin-

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der with every one and one half complete revolutions of the drive shaft.

In accordance with another feature of the invention, the fabric material is formed as a seamless cylindrical sleeve having open ends which can be quickly and easily removed and replaced over the roller shell. The fabric sleeve is attached to the rollers by end caps which clamp the open ends of the sleeve inside the ends of the shell, and the shell is mounted to the frame by spring biased stub axles which permit the cylinders to be quickly and easily removed from the frame for replacement or repair.

The transfer device of the present invention provides a new and unique method for supporting the wet ink side of a printed sheet during transfer from the impression cylinder in the delivery system of a press of the type employing a one and one half to one delivery system, and operates in a highly reliable and effective manner to prevent marking and marring of the printed sheet, yet is simple in construction and economical to manufacture. Other features and advantages of the present invention will become more apparent from the following detailed description, taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side plan view, partly in cross-section of a printing press employing a one and one half to one delivery system, and showing a prior art skeleton wheel used in the delivery system;

FIG. 2 is an enlarged, fragmentary elevational view of the prior art skeleton wheel illustrated in FIG. 1;

FIG. 3 is an enlarged fragmentary side elevational view, partly in cross-section, showing the delivery system of the invention as used in place of the prior art skeleton wheel shown in FIG. 2;

FIG. 4 is an enlarged perspective view, partially shown in exploded form, of a roller assembly forming the delivery system of the present invention, and illustrating the assembly prior to mounting in the press of FIG. 1;

FIG. 5 is an enlarged fragmentary perspective view, partially in cut away cross-section, of one end of a roller forming part of the assembly shown in FIG. 4; and

FIG. 6 is a side elevational view of a modified roller assembly of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

As shown in the exemplary drawings, the present invention is embodied in a new and improved transfer device, generally designated in FIG. 3 by the reference numeral 10, for supporting a printed sheet 12 during transfer of the sheet by the delivery system of a sheet-fed, off-set rotary printing press 14 of the type employing a one and one half to one delivery system. In this instance, illustrated in FIGS. 1 and 2, is a conventional sheet-fed, off-set rotary press 14 such as that made by A.B. Dick, Co. under its model number 360 and which is shown with a conventional prior art one and one half to one delivery system designated generally by the reference numeral 16. The press 14, which is schematically illustrated herein for simplicity, includes a sheet feeder station 18 wherein individual sheets 12 to be printed are stacked and fed sequentially into the press, and a printing station 20 comprising a plate cylinder 22, a blanket cylinder 24, and an impression cylinder 26 having sheet grippers 28 for gripping and holding the sheet during movement through the printing station. The delivery system 16 functions to pull the freshly printed sheet 12 from the impression cylinder 26 and to convey the sheet to either another printing station or to a delivery station 30 as herein shown, where the printed sheets are stacked for removal from the press 14.

In a press 14 of the type employing a prior art one and one half to one delivery system 16, the delivery system includes a skeleton wheel 32 mounted on a rotary drive shaft 34 extending laterally across the press adjacent the impression cylinder 26, and which functions as a transfer device to support the freshly printed side of the sheet 12 during transfer of the sheet from the impression cylinder. To remove a freshly printed sheet 12 from the impression cylinder 26 and pull the sheet to the next station, the delivery system 16 has a pair of parallel endless driven conveyor chains 36 trained around sprocket wheels 38 mounted on the lateral ends of the drive shaft 34, and which carry laterally disposed gripper bars 40 having grippers 42 for gripping the leading edge of the printed sheet adjacent the impression cylinder. As shown herein, the gripper bars 40 include a conventional cam operated mechanism (not shown) for causing the grippers 42 to open and close to grip the leading edge of a sheet 12 as the gripper bar passes the impression cylinder 26. To actuate the cam operated mechanism of the grippers 42, a cam plate 44 is attached to one of a pair of laterally spaced press frame supports 46, herein the right support as seen in FIG. 2, the supports being disposed laterally inwardly of the conveyor chains 36 and serving to support the lateral end portions of the drive shaft 34 which is journaled therethrough. As the gripper bar 40 passes over the cam plate 44, the cam plate actuates the cam operating mechanism to open and close the grippers 42 at the appropriate position to grip and pull a sheet 12 from the impression cylinder 26.

The gripper bars 40 are longitudinally spaced along the conveyor chains 36 such that the drive shaft 34, and hence the sprocket wheels 38 and skeleton wheel 32, will make one and one half complete revolutions between each passage of one gripper bar 40 past the impression cylinder 26. In this manner, the drive shaft will make one and one half revolutions during transfer of each individual sheet 12 from the impression cylinder 26. A rotary press 14 having this type of delivery system is conventionally known in the printing industry as a press having a one and one half to one delivery system.

With conventional presses 14 having a prior art one and one half to one delivery system 16, it is not possible to use a cylindrical roller concentrically mounted on the drive shaft 34 such as disclosed in the before mentioned DeMoore Patent Nos. 3,791,644 and 4,402,267 since the gripper bars 40 must be able to pass around the periphery of the skeleton wheel at two diametrically spaced locations due to the one and one half to one delivery system cycle. Prior to the present invention, it was typical that prior art one and one half to one delivery systems 16 use one or more segmented skeleton wheels 32 having two diametrically opposed openings 48 for permitting the gripper bars 40 to pass around the skeleton wheel adjacent the outer periphery of the impression cylinder 26 as each sheet 12 was transferred.

In an effort to minimize marking and smearing of the freshly printed sheet 12 during transfer from the impression cylinder 26 in such prior art delivery systems 16, the segmented skeleton wheel 32 is adjustably mounted

to the drive shaft 34 so that the skeleton wheel can be laterally positioned along the drive shaft as shown by the phantom line positions illustrated in FIG. 2, to attempt to place the area of contact of the skeleton wheel outer periphery on the sheet where minimum wet ink is present. Thus, for each particular printing job, the position of the skeleton wheel 32 in prior art delivery systems 16 was required to be adjusted in an attempt to minimize sheet marking and marring, thereby requiring that the press 14 be stopped between each job. In many printing situations, it is not possible to position the segmented skeleton wheel 32 in a position where it will not contact wet ink, and the sheet 12 will be marked or marred regardless of where the skeleton wheel is positioned. Moreover, in an effort to further reduce marking, prior art delivery systems 16 typically employ skeleton wheels 32 having outer peripheral edges 50 which are relatively narrow, or even sharp for reducing the area over which the skeleton wheel contacts the sheet 12. The narrow edge 50 of prior art skeleton wheels 32 have been found to cause depressions in the freshly printed surface of the sheet 12, and may cause sheet creasing or tearing due to the uneven and very small support area afforded by the outer peripheral edge of the skeleton wheel.

In accordance with a primary aspect of the present invention, the new and improved transfer device 10 eliminates the need for skeleton wheel adjustment between printing jobs, and substantially eliminates any sheet marking and marring of the freshly printed sheet 12 while providing uniform and effective support for the freshly printed sheet over substantially its full width during transfer from the impression cylinder 26 of the press 14. Further, the present invention provides a transfer device 10 which is highly reliable and effective in use, and which is relatively economical to manufacture and easy to install and maintain in place of prior art skeleton wheels 32 found in existing presses 14 without requiring any press modification.

Toward the foregoing ends, as best shows in FIGS. 2 and 4, the transfer device 10 of the present invention includes a plurality of individual rollers 52, herein two such rollers, formed as continuous cylindrical shells 54 mounted by stub axles 56 to an elongated frame 58 secured to the drive shaft 34 for rotation therewith, and which engage and support the wet ink surface of the sheet 12 across substantially the full width of the sheet. As best seen in FIG. 4, the frame 58, which preferably is made of metal, herein is formed to have a generally "C" shaped cross-section defined by generally flat parallel side walls 60 and a generally flat bottom wall 62, the side walls and bottom wall defining an elongated channel 64 dimensioned to receive the drive shaft 34. To mount the rollers 52 to the frame 58, a pair of end plates 66 are secured, herein by bolts 68, to each of the ends of the frame, the length of the frame and end plates being dimensioned to fit along the drive shaft 34 within the lateral space between the press frame supports 46.

The end plates 66 are each provided with generally "C" shaped slots 70 formed centrally therein and which are aligned with the channel 64 of the frame 58 for receiving the drive shaft 34. Each of the end plates 66 forms a pair of mounting flanges 72 which project outwardly from opposite sides of the slot 64 beyond the side walls 60 of the frame 58, and to which the stub axles 56 of the rollers 52 are coupled. For rigidly mounting the frame 58 to the drive shaft 34, a series of clamps 74, herein three in number and formed as rectangular brackets having "C" shaped openings 76 in each end through which bolts 78 extend, are secured to the frame side walls 60 over the open end of the channel 64 to securely clamp the drive shaft within the channel. With this arrangement the frame 58 and rollers 52 can be quickly and easily installed on the drive shaft 34 without requiring any modification in the press 14.

As can best be seen in FIGS. 4 and 5, the rollers 52 are releasably mounted to the flanges 72 of the frame 58 for free rotation by the stub axles 56 which project axially from each end of each roller and which are received in elongated slots 80 formed on diametrically opposed sides of the device shaft 34 in opposed ends of the flanges so that the axis of each roller is parallel with the axis of the drive shaft 34. With particular reference to FIG. 5, the stub axle 56 at each end of the rollers 52 comprises a cylindrical shaft 82 having an outer end 84 projecting beyond the end of the shell 54, and an inner end 86 extending inside the shell, and is coupled to the shell by a support 88 herein formed as a doughnut shaped block having an outer peripheral surface 90 secured to the inner cylindrical surface of the shell, and an inner peripheral surface 92 spaced radially outwardly of the shaft. The inner end portion of each stub axle 56 is journaled to the support block 88 through a roller bearing assembly 94 comprising an inner race 96 engaged with the outer periphery of the shaft 82, an outer race 98 seated within a recess 100 formed in the inner peripheral surface 92 of the support block, and a plurality of roller bearings 102 disposed between the races to permit the shell 54 to rotate freely relative to the stub axle.

For releasably mounting the rollers 52 to the frame 58, the stub axles 56 are spring loaded so that they can be quickly and easily removed from the mounting flanges 72. Disposed inwardly of the outer end 84 of the shaft 82 is an enlarged diameter collar 104 of circular cross-section, against the inner side of which abuts one end of a compression spring 106 encircling the shaft, the opposite end of the spring abutting against the inner race 96 to bias the shaft axially outwardly from the end of the roller 52. To prevent the stub axle 56 from being completely withdrawn from the roller 52, the inner end 86 of the shaft 82 has a disc shaped stop 108 formed thereon which has a diameter larger than that of the inner surface 92 of the support block 88 and which will abut against the block to prevent the shaft 82 from being removed.

When installed in the frame 58, the stub axle 56 projects outwardly through the slots 80 in the flanges 72 with the collar 104 frictionally engaged against the flange under the bias of the spring 106. To insure that the collar 104 does not slip against the flange 72 and allow the roller 52 to come off the flange, a circular recess 110 having a diameter substantially equal to that of the collar is formed in the flange adjacent the closed end of the slot 80. In order to remove the roller 52 from the frame 58, all that is necessary is to depress the outer end 84 of one of the stub axles 56, as indicated by the arrow 112 of FIG. 5, and move the stub axle to the phantom line position shown to release the collar 104 from the recess 110, and then slide the shaft 82 outwardly along the slot 80 until the roller is free of the frame.

To prevent marking and marring of the freshly printed sheet 12 during operation of the press 14, the shell 54 of each of the rollers 52 is made as a right circular cylinder, preferably of metal or plastic, having a

continuous outer peripheral surface 114 coated with a low-friction, self lubricating material such as polytetrafluoroethylene, and is loosely covered with a fabric material 116, such as is more particularly described in the above noted DeMoore Pat. No. 4,402,267. In accordance with another important aspect of the present invention, the fabric covering 116, which preferably is made of a loosely woven material such as cheesecloth and impregnated with a liquid repellant substance such as that sold under the trademark "Scotchguard" manufactured by the 3M Company of Minneapolis, Minnesota, is formed as a seamless cylindrical-shaped sleeve having open ends 118, and which can be quickly and easily slipped over the roller shell 54 for removal and replacement.

To releasably attach the fabric sleeve 116 to each roller 52, the ends 118 of the sleeve are folded over the ends of the shell and pressed inside the shell, preferably against a fastener strip 120 such as that sold under the trademark VELCRO, disposed around the inner periphery of the shell adjacent the ends. The fasteners 120 grip and hold the fabric sleeve ends 118, and end caps 122, herein formed as cup shaped members having enlarged radial flanged outer ends 124 and bottoms 126 formed with a central opening 128 for receiving the stub axle 56 therethrough, are press fit into the ends of the shell 54 to firmly clamp the ends of the fabric within the shell. With this arrangement, should it be necessary to replace the fabric sleeve 116 of a roller 52, such as may be required if the fabric has become soiled or torn, all that is necessary is that the roller be removed from the frame 58 and the end caps 122 pulled from the ends of the shell 54. The sleeve 116 can them be pulled from the fastener 120, slid off the roller 52 and a new sleeve pulled over the shell 54 and the ends inserted into the ends of the shell and secured against the fasteners 120 with the end caps 122. The roller 52 with the new sleeve 116 can then be quickly and simply replaced in the frame 58 and the press 14 is ready for continued use.

With the transfer device 10 of the present invention, it has been found that marking and marring of freshly printed sheets is substantially eliminated. Due to the free rotation mounting of the rollers 52 to the frame 58, any difference in the speed of rotation of the transfer device 10 relative to the impression cylinder 26 is automatically compensated by rotation of the roller relative to the frame. Thus, as a freshly printed sheet 12 is pulled from the impression cylinder 26 into engagement with a roller 52, the sheet wall immediately attached to the fabric covering 116 and the roller can rotate about its stub axles 56 to prevent any relative movement of the sheet with respect to the fabric covered surface of the shell 54, thereby preventing marking and marring of the wet ink sheet surface. Moreover, since the rollers 52 extend across the full width of the sheet 12, uniform and effective support for the sheet over a substantial area of contact is provided.

In FIG. 6 is illustrated a modified frame 68' for supporting four rollers 52 in a transfer device 10 of the invention, parts of the modified frame having a common function with those of the frame 68 of the embodiment shown in FIGS. 3–5 being designated by corresponding primed reference numerals. As shown in FIG. 6, the modified frame 58', which has an elongated generally C-shaped appearance including an elongated channel 64' formed by elongated side walls 60' and a bottom wall 62', has a pair of end plates 66' (only one of which is shown), and which permit two rollers 52 to be releasably mounted to each flange 72'. The flange 72' project outwardly from opposed sides of the channel 64' within which the drive shaft 34 is mounted, and include four elongated slots 80' for receiving and retaining the stub axles 56 of the rollers 52, each pair of slots in one flange being diametrically opposed across the drive shaft 34 from the corresponding slots in the other flange. With this embodiment, sufficient space is still provided for passage of the gripper bar 40 each one and one half revolutions of the drive shaft 34, but more support area is provided for the sheet 12 since four fabric covered rollers 52 will engage and support the sheet during each revolution of the transfer device 10.

From the foregoing, it should be apparent that the new and improved transfer device 10 of the present invention can be quickly and easily installed in the delivery system of presses 14 of the type having a one and one half to one delivery system in place of the prior art skeleton wheels 32 with out requiring press modification, and when so installed, will provide uniform support for freshly printed sheets 12 over a broad area of contact yet substantially prevent marking and marring of the wet ink. Further, with the transfer device 10 of the present invention, it will no longer be necessary to stop the press 14 to adjust the position of skeleton wheels 32, and the press can be operated continuously with out danger of marking or marring regardless of the type of print job being done. Should it become necessary to replace a fabric covering 116 on any roller 52, replacement can be quickly and easily accomplished with out requiring the press 14 to stopped for prolonged periods of time.

As illustrated herein, the axes of the rollers 52 are aligned along a diametrical plane passing through the center of the axis of rotation of the drive shaft 34, and the rollers are spaced outwardly from the side walls 60 of the frame a distance sufficient to permit the rollers to freely rotate about their stub axles 56. It should be appreciated that although two and four roller embodiments have been herein illustrated, the transfer device 10 of the present invention may employ additional rollers by appropriately modifying the end plates 66 for support of additional rollers, the critical parameters being that the axis of rotation of each roller be parallel with the axis of rotation of the drive shaft 34, and that the spacing of the rollers about the frame 58 be sufficient to permit the gripper bars 40 to pass between the rollers adjacent the impression cylinder 26.

While particular form of the present invention have been illustrated and described, it should be appreciated that various modifications and variations therein may be made without departing from the spirit and scope of the invention.

I claim:

1. In combination with a sheet-fed rotary printing press having an elongated impression cylinder for printing one side of a sheet with ink; and a one and one half to one delivery system for transferring a printed sheet from the impression cylinder to a further processing station of the press, said delivery system including:

an elongated drive shaft extending parallel to said impression cylinder;

a pair of sprocket wheels mounted for rotation to said press and coupled to the lateral ends of said drive shaft;

a pair of endless and parallel conveyor chains, one trained about each of said sprocket wheels;

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a plurality of elongated gripper bars coupled to said chains at spaced locations therealong and extending laterally therebetween parallel with said drive shaft;

a plurality of grippers laterally spaced along said gripper bar and operable to engage the leading edge of a sheet at the impression cylinder and pull said sheet from the impression cylinder, said gripper bars being positioned along said gripper chain such that said drive shaft and said sprocket wheels make one and one half complete revolutions between passage of each gripper bar; and

a transfer device for engaging and supporting the wet ink side of said sheet pulled from said impression cylinder by said grippers, said transfer drive comprising a frame drivingly coupled to said drive shaft and at least two elongated cylindrical rollers mounted to said frame and projecting radially outwardly of said drive shaft, said rollers being mounted for free rotation about axes extending parallel to said drive shaft and disposed to engage and support said wet ink side of said sheet during said transfer.

2. A transfer device as set forth in claim 1 wherein each of said rollers is releasably mounted to said frame.

3. A transfer device as set forth in claim 2 wherein each of said rollers comprises a generally hollow, cylindrical shell having open ends and axle means for supporting said shell to said frame, said shell being coupled with said axle means by bearing means for permitting said shell to rotate freely with respect to said axle means.

4. A transfer device as set forth in claim 3 wherein the outer surface of said shell is coated with a low friction material and is covered by a fabric material impregnated with a liquid repellant substance.

5. A transfer device as set forth in claim 4 wherein said fabric covering is formed as a seamless cylindrical sleeve having open ends.

6. A transfer device as set forth in claim 3 wherein said axle means comprises a pair of stub axles having inner end portions disposed within said shell and outer end portions projecting outwardly from each end of said shell, the inner end portions being journaled through said bearing means and axially shiftable between extended and retracted positions relative thereto such that the outer end portions can be retracted inwardly with respect to said shell for release of said roller from said frame.

7. A transfer device as set forth in claim 6 wherein said bearing means comprises an inner bearing race surrounding said inner end portion of each of said stub axles and an outer bearing race coupled to said shell, said inner and outer bearing races being coupled by bearing elements for relative rotation.

8. In a sheet fed rotary printing press of the type having an impression cylinder for printing one said of a sheet with wet ink, and a one and one half to one delivery system for transferring the printed sheet from the impression cylinder to another processing station within the press, the delivery system including a transfer device driven by a drive shaft disposed adjacent the impression cylinder, and operating to engage and support the wet ink side of the printed sheet during the transfer, said transfer device comprising:

a frame drivingly coupled to said drive shaft and at least two elongated cylindrical rollers releasably mounted to said frame on diametrically opposed sides of said drive shaft, said rollers being mounted for free rotation about axis extending parallel to said drive shaft and disposed to engage and support said wet ink side of said sheet during said transfer, each of said rollers comprising a generally hollow, cylindrical shell having open ends and axle means for supporting said shell to said frame, said shell being coupled with said axle means by bearing means for permitting said shell to rotate freely with respect to said axle means; and

said axle means further comprising a pair of stub axles having inner end portions disposed within said shell and outer end portions projecting outwardly form each end of said shell, the inner end portions being journaled through said bearing means and axially shiftable between extended and retracted positions relative thereto such that the outer end portions can be retracted inwardly with respect to said shell for release of said roller from said frame.

9. A transfer device as set forth in claim 8 wherein each of said stub axles is spring biased toward the extended position.

10. A transfer device as set forth in claim 9 wherein each of said rollers is covered with a fabric material.

11. A transfer device as set forth in claim 10 wherein said fabric is a loosely woven cloth impregnated with a liquid repellant substance, and is formed as a seamless cylindrical sleeve having open ends.

12. A transfer device as set forth in claim 11 wherein the open ends said fabric sleeve are folded into the ends of said shell and a pair of end caps are press fit into the ends of said shell to retain said sleeve on said shell.

13. A transfer device as set forth in claim 9 wherein said frame comprises an elongated, generally C-shaped frame extending laterally along said drive shaft, said frame having lateral ends defining a pair of diametrically disposed mounting flanges for mounting said rollers there between.

14. A transfer device as set forth in claim 13 wherein each of said mounting flanges includes an opening for receiving the outer end portion of said stub axle, said rollers being removable from said frame by retracting said outer end portion against the bais of said spring to disengage said stub axle from said opening.

15. A transfer device as set forth in claim 14 wherein two rollers are mounted to said frame.

16. A transfer device as set forth in claim 14 wherein four rollers are mounted to said frame.

17. For use in a sheet fed rotary printing press of the type including an impression cylinder for printing a sheet and a drive shaft driving a one and one half to one delivery system for transferring the printing sheet from the impression cylinder to another processing station within the press, a transfer device comprising:

a frame mounted to said drive shaft;

at least two rollers releasably supported by said frame and arranged to engage and support said printed sheets during said transfer, each of said rollers comprising an elongated cylindrical shell formed to have a continuous outer peripheral surface and open ends, said rollers each being mounted to said frame for free rotation about axes parallel to said drive shaft and supported by bearing means for free rotation about a pair of stub axles lying along said axes, said stub axles projecting outwardly from said ends of said shell and being releasably coupled to said frame;

a fabric material covering said outer peripheral surface of each of said rollers, said fabric material being a loosely woven cloth impregnated with a liquid repellant substance and formed as a seamless cylindrical sleeve having open ends, said open ends of said sleeve being inserted into said open ends of said shell; and

end caps releasably press fit within said open ends of said shell to retain said sleeve on said shell.

18. In combination with a sheet fed rotary printing press of the type including an elongated impression cylinder for printing one side of a sheet with wet ink, a one and one half to one delivery system for transferring the printed sheets from the impression cylinder to another processing station within the press, said delivery system including an elongated drive shaft extending parallel to said impression cylinder and supporting a transfer device, said transfer device comprising:

a frame mounted to said drive shaft, and at least two elongated rollers releasably supported by said frame and arranged to engage and support the wet ink side of said printed sheet during said transfer, said rollers each being mounted to said frame on opposed sides of said drive shaft for free rotation about axes parallel to said drive shaft.

19. A transfer device as set forth in claim 18 wherein said rollers are each formed to have a continuous outer peripheral surface covered by a fabric material.

20. A transfer device as set forth in claim 19 wherein said fabric material is a loosely woven cloth impregnated with a liquid repellant substance, and is formed as a seamless cylindrical sleeve having open ends.

21. A transfer device as set forth in claim 20 wherein each of said rollers comprises an elongated cylindrical shell having open ends and supported by bearing means for free rotation about a pair of stub axles lying along said axes, said stub axles projecting outwardly from said ends of said shell and releasably coupled to said frame.

22. A transfer device as set forth in claim 21 wherein said open ends of said sleeve are inserted into said open ends of said shell and end caps are releasably press fit within said open ends of said shell to retain said sleeve on said shell.

23. A transfer device as set forth in claim 22 wherein said shell has an outer cylindrical support surface coated with a low friction material.

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(52) UK CL (Edition L)
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GB 0924401 A US 4165688 A

(58) Field of search
UK CL (Edition L) B6C CEBB CEBE CEBX
INT CL[5] B41F
On-line database: WPI

(54) Printing apparatus

(57) A divider seal 10 for a split-fountain chambered doctor blade for a printing press, comprising a seal contoured to sealingly engage a circumferential surface of a rotating cylinder, a seal retainer for retaining the seal in sealing engagement with the rotating cylinder, and pneumatic biasing structure, such as a pneumatic bladder, acting on the seal retainer for resiliently biasing the seal into sealing engagement with the rotating cylinder. The seal is located axially between the ends of the ink fountain 12 to allow different coloured inks to be used. A recess 38 is fed with water via channels 40, 42. Components of the seal may be of high molecular weight foam material aluminium or moulded plastics.

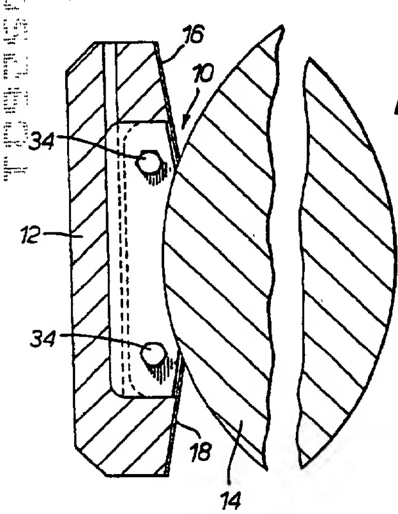

Fig. 1.

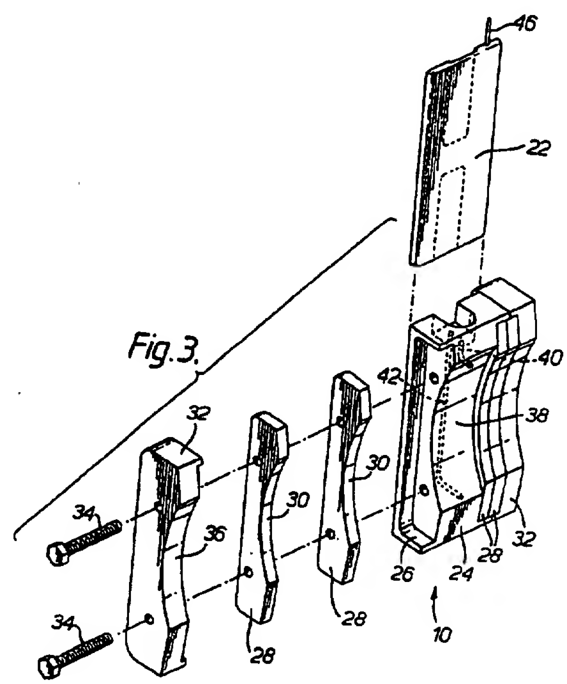

Fig. 3.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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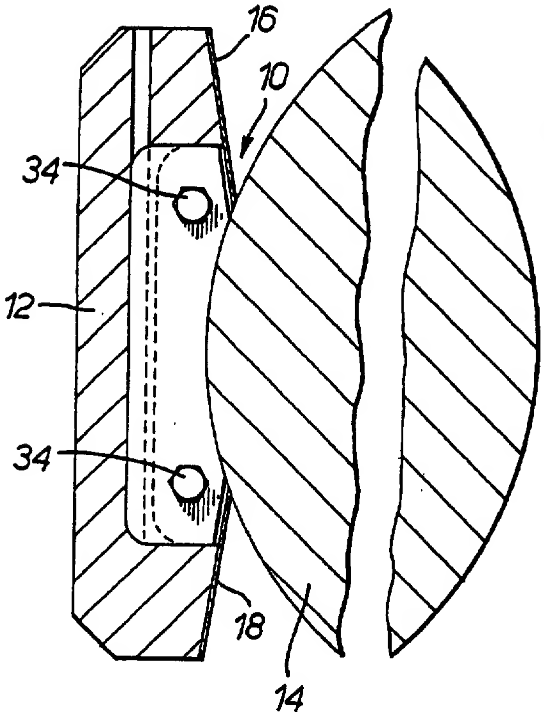
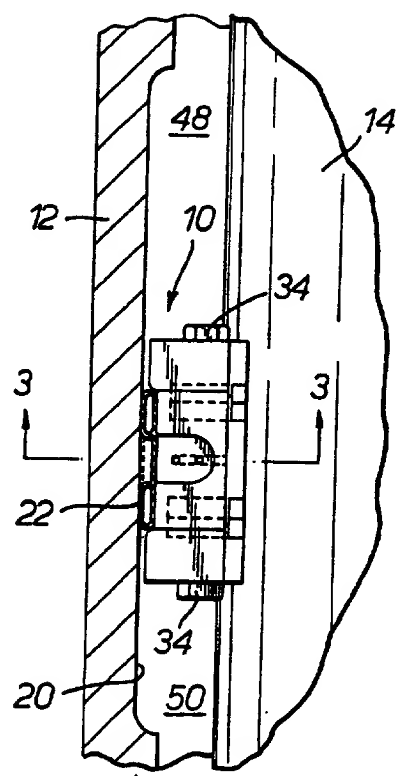


Fig. 1.

Fig. 2.



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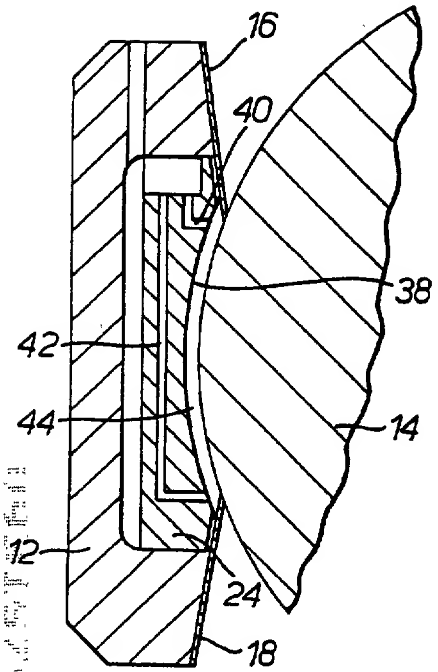

Fig.4.

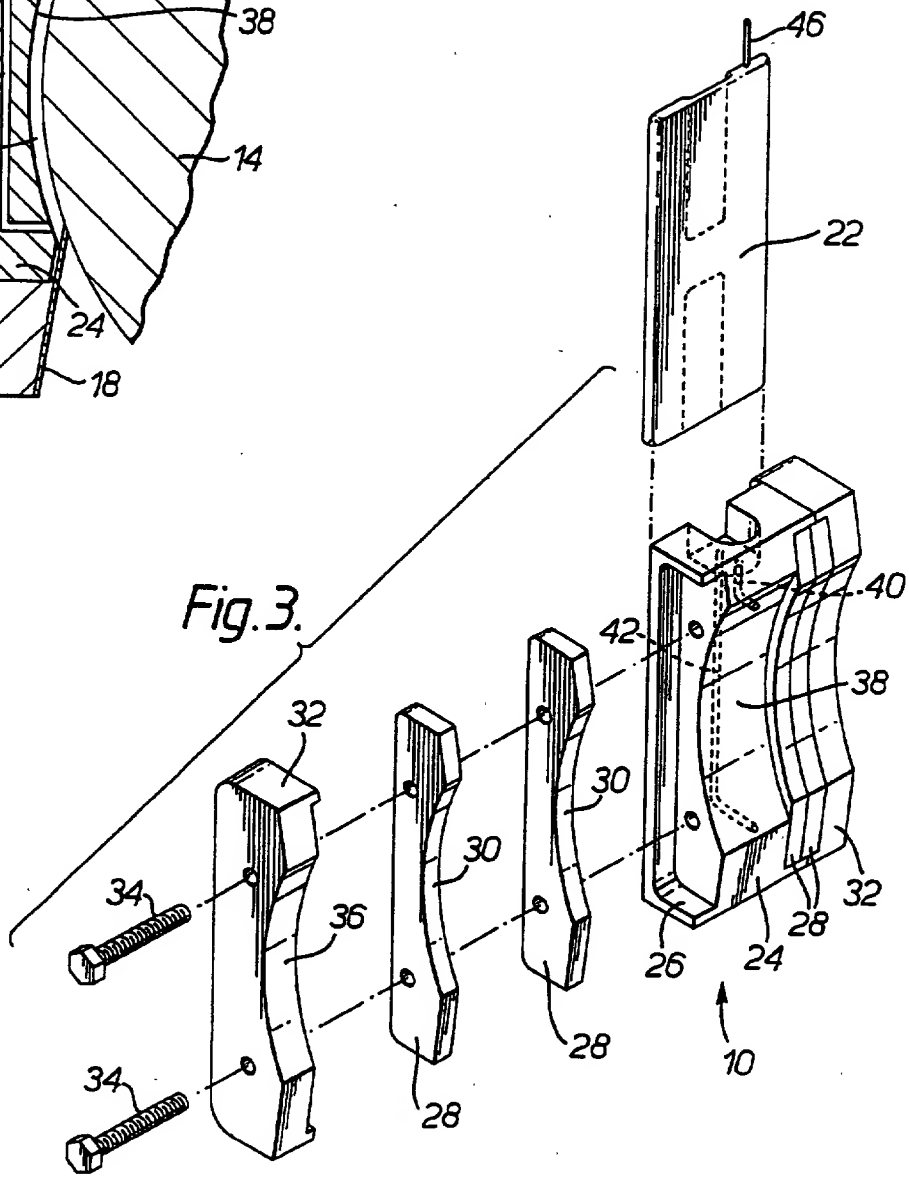

Fig.3.

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Printing Apparatus

The present invention relates particularly to flexographic printing presses which utilise a chambered doctor blade ink fountain, and is more particularly concerned with split-fountain chambered doctor blades which permit simultaneous printing with two or more different colour inks, where the seal of the present invention may be used to divide the chambered doctor blade into two or more chambers.

Flexographic printing is a rotary letter press printing process which traditionally uses flexible rubber, or other elastomer, printing plates and liquid, fast drying ink. An advantage of flexographic printing is its simple ink distribution system.

In flexographic printing, a web to be imprinted is passed between an impression cylinder and a plate cylinder, from which the ink is transferred to the web. Ink is applied to the plate cylinder in precisely-controlled quantities by an anilox (R.T.M.) metering roll. The circumferential surface of the anilox roll is divided into a very large number of small cells (typically, 15,000 cell per square centimetre). The surface of the anilox roll is flooded with ink, thus filling the cells on the roll's surface. Ink is fed to the anilox roll by an ink fountain. A commonly-used ink fountain comprises an ink reservoir and a pair of doctor blades which contact the anilox roll above and below the reservoir. The surface of the anilox roll, the doctor blades and the reservoir define a closed chamber for containing the ink. As the anilox roll rotates, the doctor blades shave the surplus ink from the surface of the anilox roll so that ink is carried only in the interior of the cells on the roll's surface and not on the lands between cells. This results in a uniformly metered film of ink being applied to the surface of the plate cylinder.

Typically, the ink fountain extends the entire length of the anilox roll and plate cylinder. In cases where it is desired to print more than one colour on a web, which requires more than one colour of ink, the chamber containing the ink in the ink fountain is divided into two or more subchambers or compartments by ink dams or dividers. These dividers are designed to maintain a fluid-tight seal between compartments in the ink fountain and to maintain a seal against the anilox roll.

Ink fountain dividers per se are known in the art, and are illustrated in, for example, U.S. patents 3,381,517, 4,559,871, 4,667,595,

and 4,796,528.

These prior arrangements are mechanically very complex. They are thus expensive to fabricate, require careful and precise alignment, and are susceptible to misalignment in use. There is therefore a need for a simple, inexpensive divider seal which is easy to fabricate and install, requires no time-consuming alignment, can compensate for wear and misalignment, and still provides an effective divider seal. The present invention fulfils that need.

The present invention is a divider seal for a split-fountain chambered doctor blade for a printing press, comprising seal means contoured to sealingly engage a circumferential surface of a rotating cylinder, retaining means for retaining the seal means in sealing engagement with the rotating cylinder, and pneumatic biasing means acting on the retaining means for resiliently biasing the seal means into sealing engagement with the rotating cylinder.

The pneumatic biasing means offers a high degree of compliance and allows for variations in wear and alignment in use.

An example of apparatus according to this invention is shown in the accompanying drawings in which:

Figure 1 is a side elevational view, partially in section, of an ink fountain and an anilox roll, of which the ink fountain is equipped with the divider seal according to the present invention.

Figure 2 is a top plan view, partially broken away, of the divider seal and anilox roll shown in Figure 1.

Figure 3 is an exploded view of the divider seal according to the present invention.

Figure 4 is a sectional view, partially broken away, taken along the lines 3-3 of Figure 2.

Referring now to the drawings, wherein like numerals indicate like elements, there is shown in Figure 1 a divider seal 10 according to the present invention mounted in a chambered doctor blade ink fountain 12, in sealing engagement with an anilox roll 14. Anilox roll 14 has already been described and is known in the art, and need not be described in further detail, except to note that, as previously described, anilox roll 14 rotates on its axis relative to ink fountain 12. Also, ink fountain 12 has already been described and is known in the art, and will be described only with the degree of detail necessary to understand the present invention. In that regard, ink fountain 12 comprises upper and lower

doctor blades 16 and 18 which contact the surface of the anilox roll and meter the amount of ink supplied to the anilox roll by ink fountain 12. Doctor blades 16 and 18 are conventional and known in the art.

As seen in Figure 1, divider seal 10 has a sealing surface which is contoured to and contacts the surface of anilox roll 14 which extends into ink fountain 12 between doctor blades 16 and 18. Divider seal 10 is otherwise dimensioned to fit within the chamber of chambered doctor blade ink fountain 12, which is of uniform cross-section.

Figure 2 illustrates the divider seal 10 as seen from above, with ink fountain 12 partially in section to permit divider seal 10 to be clearly seen. As best seen in Figure 2, divider seal 10 is spaced a short distance from the rear wall 20 of ink fountain 12. Between the rear wall of ink fountain 12 and divider seal 10 is a biasing means in the form of a pneumatic bladder 22. Pneumatic bladder 22 may be pressurised and depressurised to apply more or less biasing force to divider seal 10, thereby controlling the loading force of divider seal 10 against anilox roll 14.

Referring now to Figure 3, the various parts of divider seal 10 are shown in an exploded view. Divider seal 10 comprises a manifold 24, which includes lateral recesses on either side. Recess 26 is visible in Figure 3. Recess 26 receives at least one, and preferably two, seal members 28. Seal members 28 are preferably made of an ultrahigh molecular weight closed foam material, and each seal means has a contoured surface 30 contoured to the curvature of anilox roll 14 so as to intimately engage the surface of anilox roll 14 when the seal means 28 are brought into contact with the surface of anilox roll 14. Seal means 28 and end cap 32 may be retained on manifold 24 by any suitable means, such as threaded fasteners 34. End cap seal 32 also has a contoured surface 36, which has substantially the same contour as contoured surface 30 of seal means 28.

Manifold 24 is substantially symmetrical along its longitudinal axis, and therefore receives a pair of seal means 28 and an end cap seal 32 on both sides.

Manifold 24 may be made of any suitable material. For example, manifold 24 may, for example, be machined from aluminium, or moulded in plastic. A preferred material for manifold 24 is aluminium with a Teflon (Registered Trade Mark) coating. End cap seals 32 are preferably moulded from an ultrahigh molecular weight plastic.

It will be seen in Figure 3 that, as with seal means 28 and end cap seals 32, manifold 24 has a contoured surface 38. However, contoured surface 28 is contoured to a curvature having a radius slightly greater than the curvature of contoured surfaces 30 and 36 of seal means 28 and end cap seals 32. This provides a small gap between anilox roll 14 and contoured surface 38, as best seen in Figure 3.

Referring now to Figure 4, manifold 24 is shown in section. Manifold 24 includes a pair of liquid flow channels 40 and 42. (Channels 40 and 42 are shown in phantom in figure 3.) These channels serve to supply and drain water to the gap 44 between contoured surface 38 and anilox roll 14. Gap 44 forms a water reservoir defined by contoured surface 38, anilox roll 14 and top and bottom doctor blades 16 and 18. Water is preferably supplied to reservoir 44 through flow channel 40 and drained, preferably by vacuum, through channel 42. The water in reservoir 44 fills the interstices in seal means 28, so that there is a film of water between seal means 29 and the surface of anilox roll 14. The film of water serves as both a low-friction bearing and a fluid seal.

Seal means 28 are biased into sealing engagement with anilox roll 14 by the pneumatic bladder 22. Bladder 22 is positioned between manifold 24 and the rear wall 20 of ink fountain 12, as previously described. Air is supplied to and exhausted from bladder 22 through an air supply conduit 46. By pressurising bladder 22, seal means 28 are biased into sealing engagement with the surface of anilox roll 14. The biasing force can be controlled by controlling the internal pressure of bladder 22. Since bladder 22 is pneumatically pressurised, bladder 22 is resilient. That is, bladder 22 permits divider seal 10 to move toward and away from rear wall 20 as anilox roll 14 rotates, to compensate for variations in the surface of anilox roll 14, such as a slightly out-of-round condition or slight misadjustment, for example where the ink fountain 12 is not exactly parallel to the axis of anilox roll 14. In addition, bladder 22 enables divider seal 10 to move toward anilox roll 14 to compensate for wear of both the surface of anilox roll 14 and the contoured surfaces 30 of the seal members 28, as a result of normal use. Since air is a compressible fluid, bladder 2 can be pressurised to a degree that will enable divider seal 10 to move toward and away from rear wall 20 of ink fountain 12, as may be required by out-of-round conditions in anilox roll 14, misalignments, and wear.

It will be appreciated that ink fountain 12 can be divided into two

or more compartments (see Figure 2) by using one or more divider seals 10. Thus, ink fountain 12 may be divided into two compartments 48 and 50 by using a single divider seal 10. If two divider seals are used, ink fountain 12 can be divided into three compartments, and so on, so that any number of compartments as desired may be provided.

It will also be noted that neither bladder 22 nor divider seal 10 are fixedly attached to rear wall 20 of ink fountain 12. Thus, divider seal 10 can be placed at any desired location along anilox roll 14, so that the lateral extent of the compartments 48 and 50 can be infinitely variable. Thus, the invention permits not only any desired number of compartments to be formed in ink fountain 12, but enables the lateral extent of the compartments so formed to be infinitely varied as desired. Hence, the present invention makes it very simple to reconfigure ink fountain 12 for different colours and dimensions. This reduces set-up time between printing runs, thereby reducing press down time and increasing equipment utilisation and throughput.

Claims

1. A divider seal for a split-fountain chambered doctor blade for a printing apparatus, comprising

a. seal means contoured to sealingly engage a circumferential surface of a rotating cylinder,

b. movable retaining means for retaining the seal means in sealing engagement with the rotating cylinder,

c. pneumatic biasing means movable with the retaining means and acting on the retaining means for resiliently biasing the seal means into sealing engagement with the rotating cylinder.

2. A divider seal according to claim 1, wherein the pneumatic biasing means comprises a pneumatic bladder.

3. A divider seal according to claim 2, further comprising means for selectably increasing and decreasing the pneumatic pressure in the bladder.

4. A divider seal according to claim 2, wherein the seal means comprises an ultra-high molecular weight closed foam.

5. A divider seal according to claim 1, further comprising a gap between the retaining means and the circumferential surface of the rotating cylinder, and means for supplying a liquid to said gap to form a liquid interface between said retaining means and circumferential surface.

6. A flexographic printing apparatus having an anilox roll and a chambered doctor blade ink fountain adjacent the anilox roller for applying printing ink thereto, a movable divider seal for dividing the doctor blade chamber into at least two compartments, the compartments containing different colour inks therein, said divider seal comprising a seal member contoured to and in sealing engagement with the outer circumferential surface of the anilox roller, a seal retainer for retaining the seal member in engagement with the circumferential surface of the anilox roller, and an inflatable and deflatable pneumatic bladder mounted between the back surface of the seal retainer and an

opposed wall of the doctor blade assembly for applying a biasing force to the seal retainer and the seal member for resiliently biasing the seal member into engagement with the circumferential surface of the anilox roller.

7. A divider seal according to claim 6, wherein said pneumatic bladder is positioned between the seal retainer and a rear wall of the ink fountain.

8. A divider seal according to claim 7, wherein the divider seal is infinitely positionable along the length of the anilox roll between the anilox roll and said rear wall of the ink fountain.

9. Printing apparatus comprising an ink fountain mounted adjacent to a roll adapted to receive a film of ink from the fountain, the fountain comprising means defining an ink chamber extending parallel to the axis of the roll, at least a portion of the chamber being of uniform cross-section and containing chamber divider which is selectively positionable at various positions in the uniformly sectioned part of the chamber and includes at least one sealing portion having a concave surface adjacent to and conforming with the surface of the roll, and including a bladder positioned between a back surface of the divider and an opposed wall of the chamber and adapted to seal the gap between the said back surface and the chamber wall and, when pressurised, to bias the concave seal surface of the divider resiliently into sealing engagement with the roll.

10. Printing apparatus according to claim 9, in which the said back surface of the divider and the said opposed chamber wall are both substantially flat and are both substantially parallel to a tangent to the roll at approximately a mid-point along the said concave surface of the sealing portion, whereby expansion of the bladder produces a series of biasing forces on the divider which are substantially parallel to a radius of the roll at the said mid-point.

11. Printing apparatus according to claim 9 or claim 10, in which the chamber divider includes a second sealing portion spaced from and similar to the first-mentioned sealing portion, the surface of the

divider between the sealing portions being recessed to define a semi-annular chamber adjacent to the roll, and including means for delivering liquid into the semi-annular chamber to form an additional barrier, supplementing the sealing effects of the seal portions, between inks contained during use in the portions of the ink chamber on opposite sides of the divider.

12. Apparatus according to any one of claims 1 to 11 and substantially as described with reference to the accompanying drawings.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

GB 9301101.3

Relevant Technical fields

(i) UK Cl (Edition L) B6C CEBB, CEBE, CEBX

(ii) Int Cl (Edition 5) B41F

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASE: WPI

Search Examiner

A DARCY

Date of Search

26 MARCH 1993

Documents considered relevant following a search in respect of claims 1-12

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 0924401 A - (TIMSON) see element 5, figure 2	1-3,6,9
X	US 4165688 A - (MAGNA-GRAPHICS) see example figure 2	1-3,6,9

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Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

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Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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United States Patent [19]

MacConnell et al.

[11] **Patent Number:** **5,088,404**

[45] **Date of Patent:** **Feb. 18, 1992**

[54] **DELIVERY APPARATUS FOR PRINTING PRESS**

[76] Inventors: **Edward P. MacConnell**, 2308 Woodcliff Ct., Arlington, Tex. 76012; **Shigeki Matsukawa**, 2807 Cripple Creek, Grapevine, Tex. 76051

[21] Appl. No.: **349,446**

[22] Filed: **May 9, 1989**

[51] **Int. Cl.**[5] **B41F 13/24**

[52] **U.S. Cl.** **101/232**; 101/246; 101/409; 271/204

[58] **Field of Search** 101/231, 232, 246, 409, 101/230, 420; 271/204, 82

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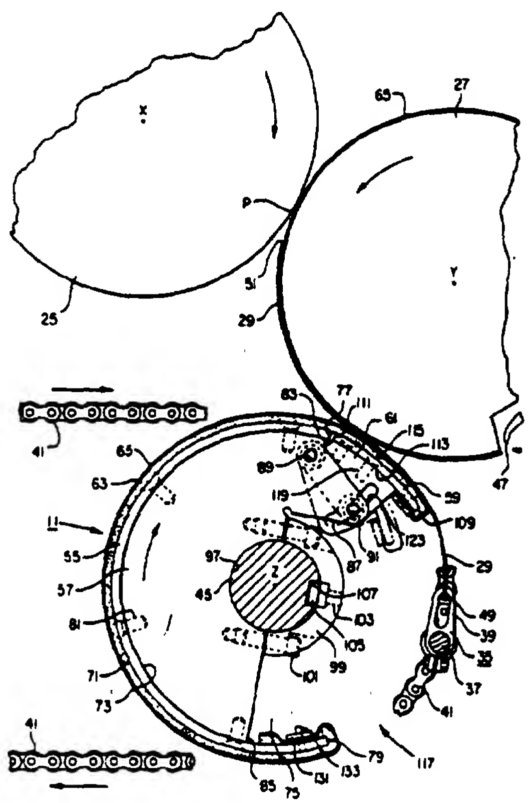
Primary Examiner—Edgar S. Burr
Assistant Examiner—Christopher A. Bennett
Attorney, Agent, or Firm—Geoffrey A. Mantooth

[57] **ABSTRACT**

A delivery apparatus which minimizes marring of wet ink is provided with an arcuate main wall and a gap forming leading and trailing edges. The leading edge can be positioned, either temporarily for adjustable versions, or permanently for nonadjustable versions, radially inward to shorten the path of a sheet exiting the last set of blanket and impression cylinders in a printing press. By shortening the sheet path, marring of wet ink against the delivery apparatus is reduced. The delivery apparatus is mounted onto a gripper bar sprocket shaft such that the gap receives the respective gripper bar. As the shaft rotates to move the gripper bar, the delivery apparatus also rotates. The outside surface of the delivery apparatus has a myriad of minute projections with rounded outer ends and being of a uniform height, which outer surface contact the wet ink side of the sheet.

16 Claims, 6 Drawing Sheets



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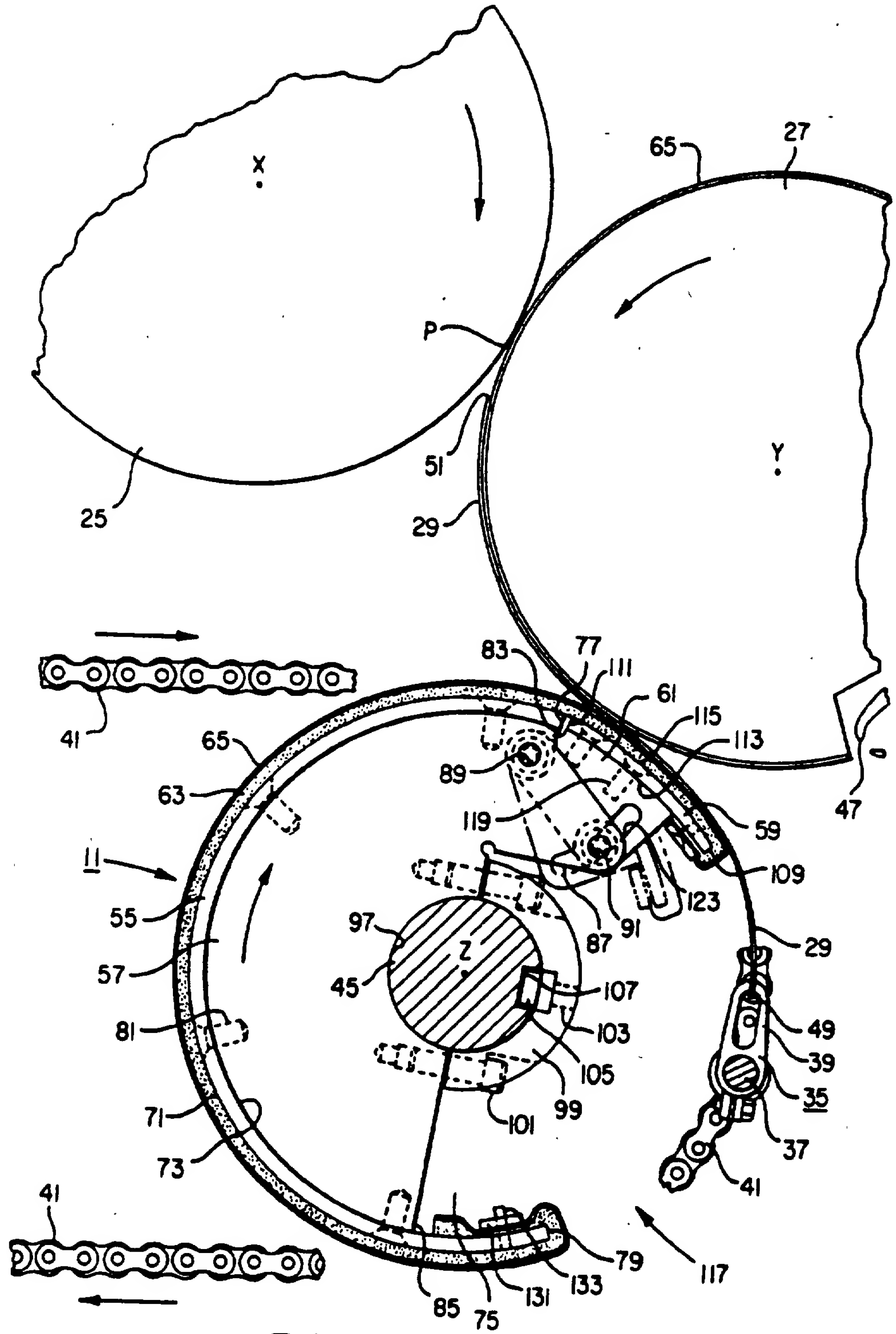

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FIG. 1

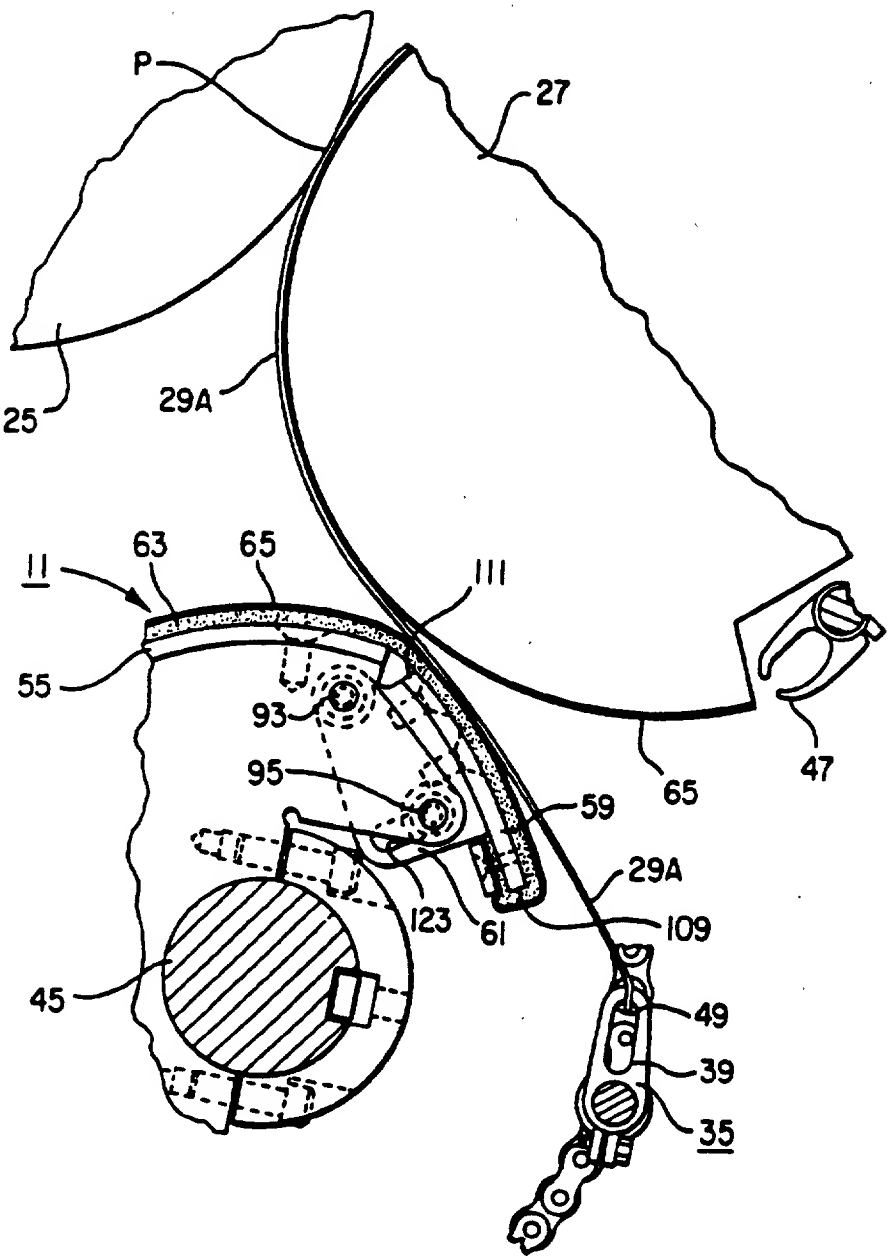

FIG. 1a

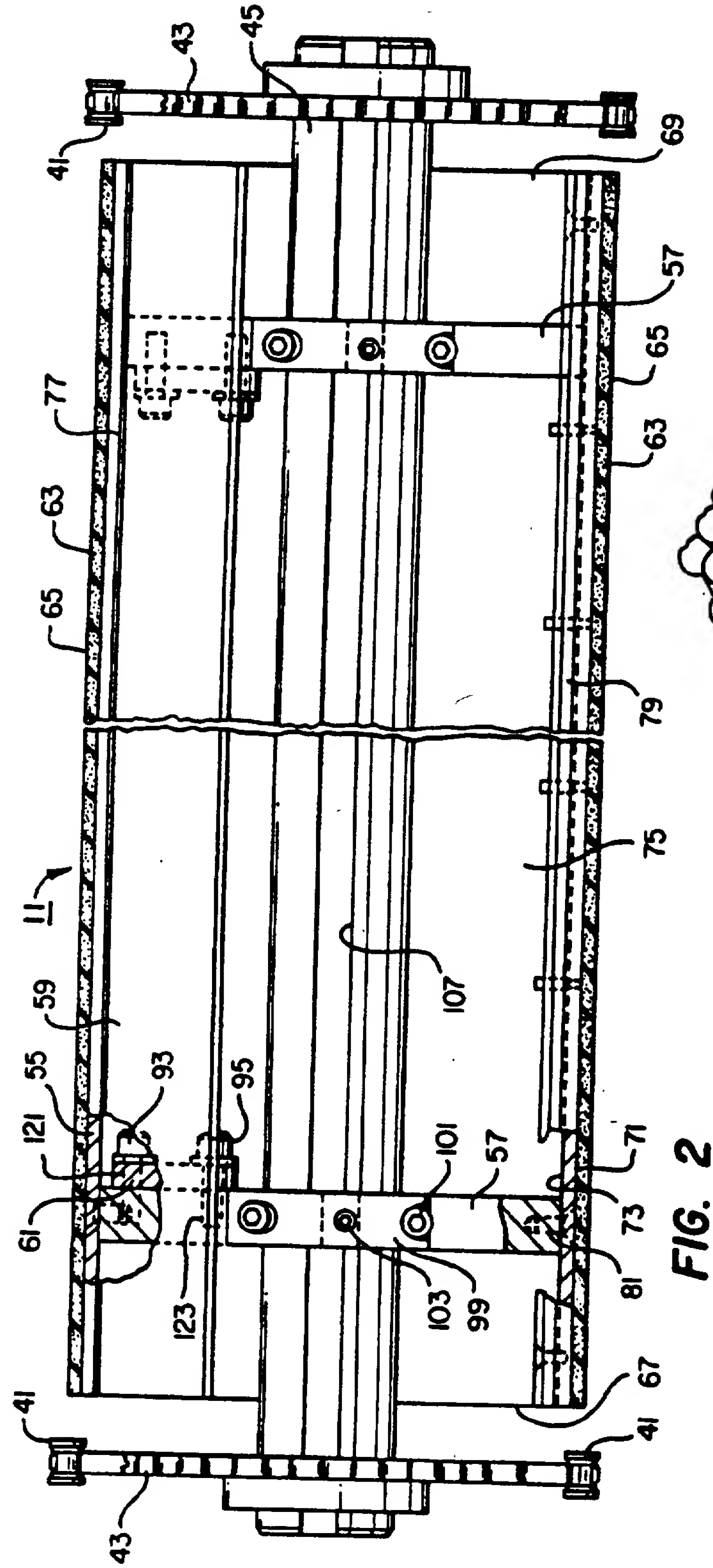
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FIG. 2

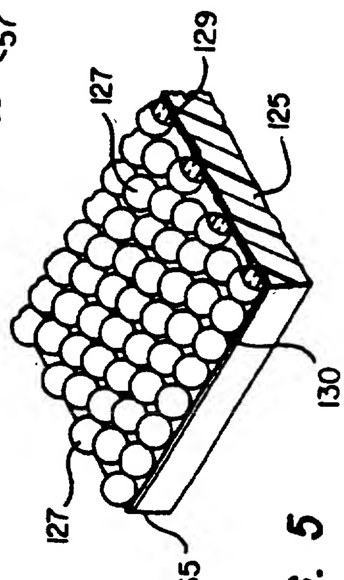
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FIG. 5

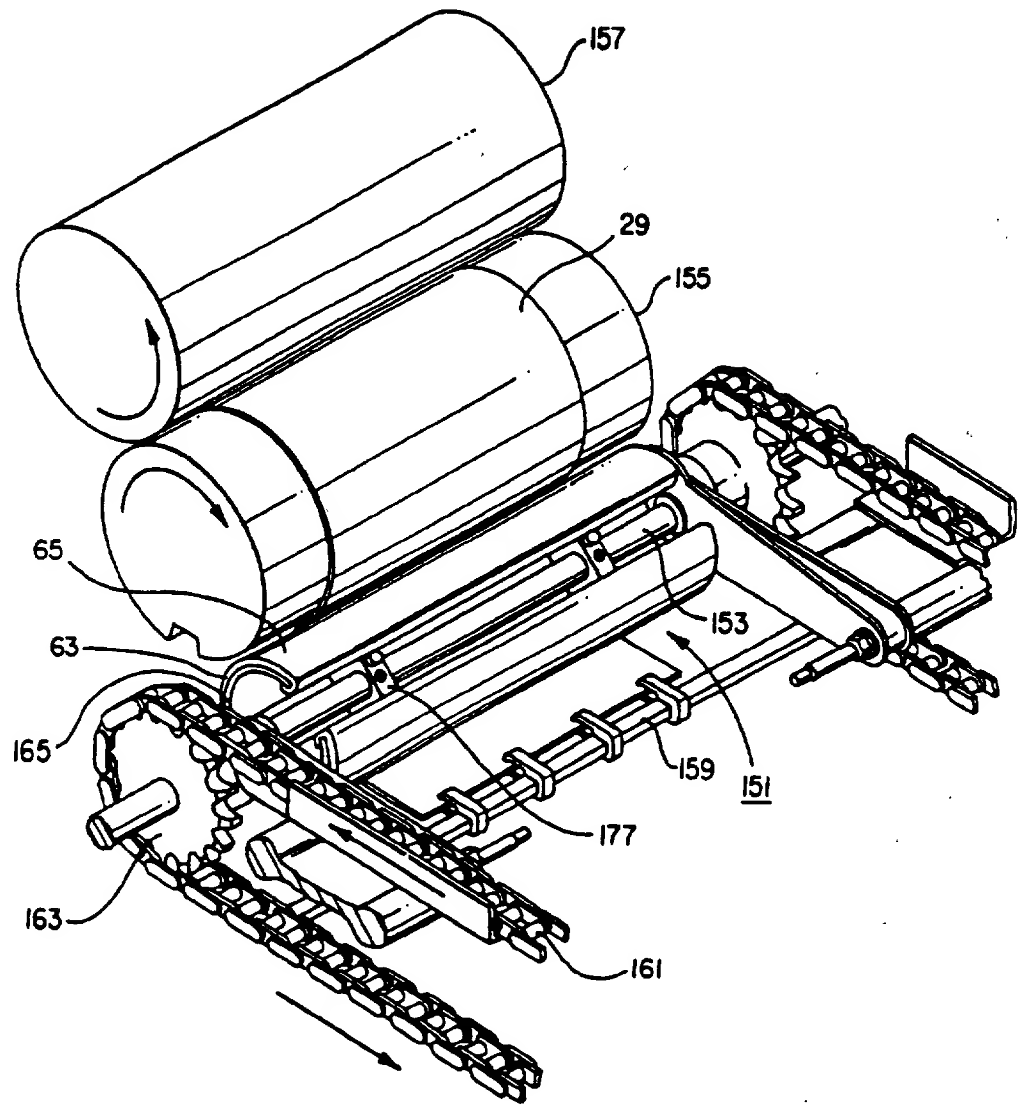

FIG. 3

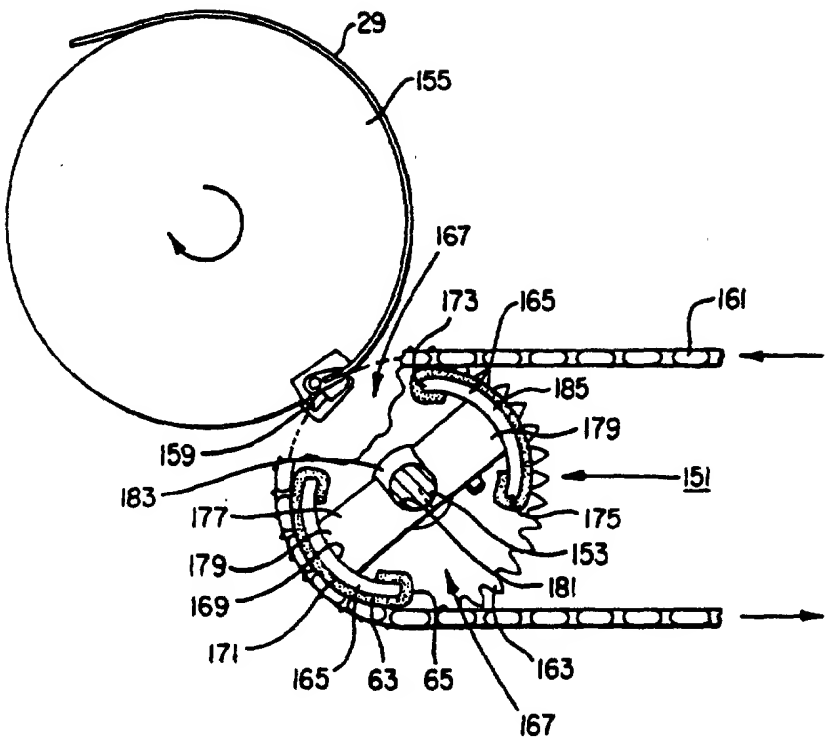
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FIG. 4

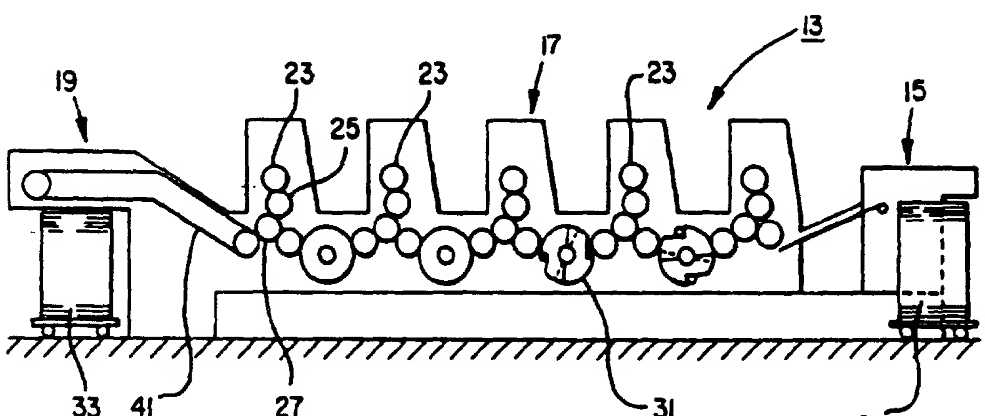
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FIG. 7

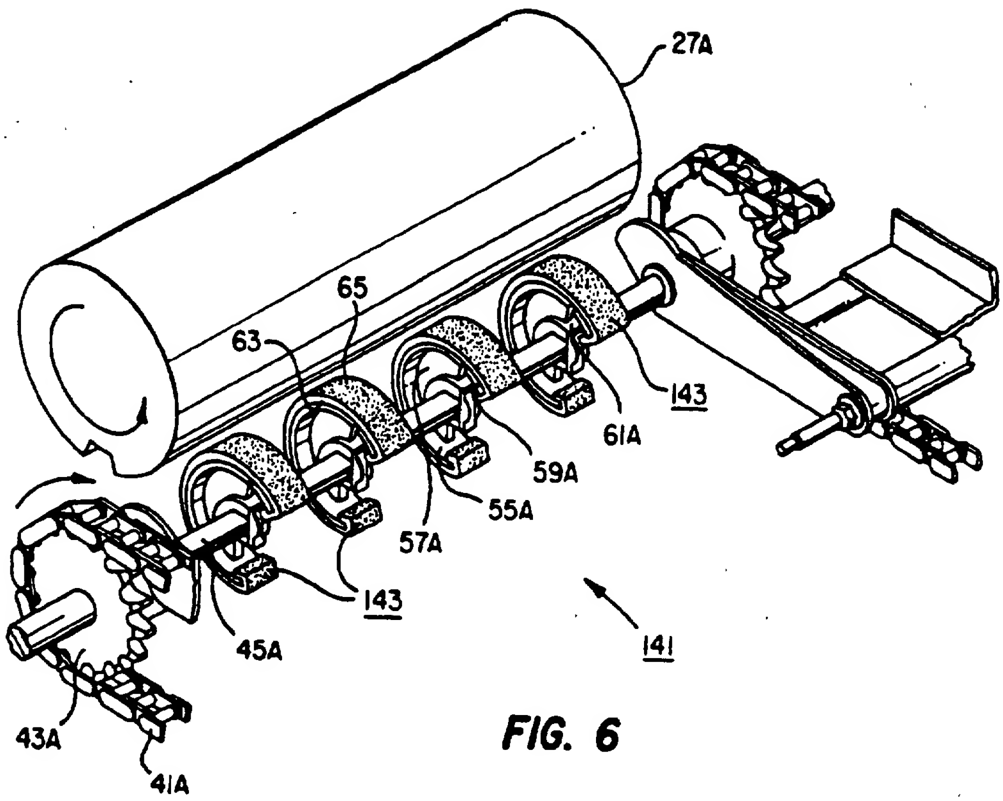

FIG. 6

DELIVERY APPARATUS FOR PRINTING PRESS

FIELD OF THE INVENTION

The present invention relates to delivery apparatuses in sheet-fed lithographic printing presses, including perfecting presses which can print on both sides of a sheet of paper.

BACKGROUND OF THE INVENTION

Sheet-fed lithographic printing presses have an infeed section, a printing section, and a delivery section. The infeed section takes individual sheets of paper from a stack of paper and delivers the sheets to the printing section. The printing section has plural rollers or cylinders, the ultimate purpose of which are to apply ink in a desired pattern or impression to the sheets of paper passing therethrough. To obtain an ink impression, a sheet of paper is squeezed between an impression cylinder and a blanket cylinder. The blanket cylinder applies wet ink to the sheet while the impression cylinder provides a hard surface for supporting the sheet during inking. As the cylinders rotate, the entire length of the sheet becomes exposed to the cylinders. Ink is applied to the blanket cylinder by plate cylinders and inking cylinders. Multicolor presses require a blanket cylinder for each color.

The delivery section removes the finished, inked sheet from the printing section and transfers it to an exit stack. The delivery section contains plural gripper bars extending transversely to the direction of sheet travel. Each gripper bar is equipped with plural grippers that grip or pinch the leading edge of a sheet as it comes out from between the last set of impression and blanket cylinders. The movement of the gripper bars are coordinated with the rotation of the impression and blanket cylinders to make the transfer of the leading edge of a sheet from the impression cylinder grippers to the gripper bar grippers. The gripper bars pull the sheets to the exit stack.

Presses using prior art delivery apparatuses have attempted to prevent or reduce the marring of wet ink. One commonly used device is known as a "skeleton" wheel in the industry. A skeleton wheel is a thin wheel positioned on a narrow nonprint area of a sheet. Because the skeleton wheel does not contact wet ink, there is no marring. Often, however, there are no nonprint areas on a sheet, the entire sheet being covered with wet ink. In this situation, skeleton wheels are useless in preventing marring. Another prior art device uses a drum covered with a netting material. This too has proven to be unsatisfactory because wet ink adheres to the netting, dries and causes marring of subsequent sheets.

Perfecting presses allow a sheet to be printed on both sides in a single run through the press. Thus, as the finished, inked sheet is brought to the delivery section of a perfecting press, both of its sides may be wet with ink, requiring care in its handling. Contact with the wet ink on one or both sides of the sheet can result in unsightly smearing or marring of the ink. Perfecting presses have problems with ink marring when the sheet contacts the last few impression cylinders. If the side of the sheet laying against the impression cylinder is wet with ink, the sheet tends to jiggle, thus destroying the registry of the sheet on the impression cylinder and causing unsightly and unintentional overlap of the various colors. In the prior art, impression cylinders have been covered with a sandpaper-like sheet material. The sheet material has a paper backing, making it unsuitable for extended use. After a period of time, the sheet material becomes dirty with ink. Cleaning is impossible, because the solvents which are required to clean the ink destroy the paper backing. Another prior art device roughens the outside surface of the impression cylinder. After a period of time, the outside surface becomes smooth, requiring reworking to roughen the surface once again, an expensive procedure.

It is an object of the present invention to provide a delivery apparatus for a sheet-fed lithographic printing press, which delivery apparatus reduces marring of wet ink.

It is a further object of the present invention to provide an apparatus for use on impression cylinders, in sheet-fed lithographic printing presses, which apparatus will reduce sheet movement of sheets having wet ink down against the impression cylinder.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side view of the delivery end of a printing press, showing an end of the delivery apparatus of the present invention, in accordance with a preferred embodiment, wherein the leading edge wall is in the outermost position and the press has a short sheet of paper.

FIG. 1a shows the press of FIG. 1, wherein the leading edge wall is in the innermost position and the press has a long sheet of paper.

FIG. 2 is a schematic partial cross-sectional side view of the delivery apparatus of FIG. 1, showing the leading edge wall and not showing the gripper bar.

FIG. 3 is a schematic isometric view of the delivery end of a small printing press, showing a delivery apparatus, in accordance with another embodiment.

FIG. 4 is a schematic end view of the delivery apparatus of FIG. 3.

FIG. 5 is a schematic detail view of the glass-beaded film.

FIG. 6 is a schematic isometric view of the delivery end of a printing press, showing a delivery apparatus in accordance with another embodiment.

FIG. 7 is a schematic side view of a perfecting printing press.

DESCRIPTION OF PREFERRED EMBODIMENTS

In FIGS. 1 and 2, there is shown the delivery apparatus 11 of the present invention, in accordance with a preferred embodiment. The delivery apparatus is used at the exit end of a sheet-fed offset lithographic printing press 13, such as is shown schematically in FIG. 7.

Referring to FIGS. 1 and 7, the printing press 13 has a infeed section 15, a printing section 17, and a delivery or exit section 19. The infeed section 15 takes individual sheets of paper from a stack of paper 21 and brings the sheets to the printing section 17. The printing section 17 has plural inking means 23, with each inking means including a blanket cylinder 25 and an impression cylinder 27. Individual sheets 29 of paper travel between the blanket and impression cylinders 25, 27. The blanket cylinder 25 applies ink to one side of a sheet 29 of paper in a desired pattern. The impression cylinder 27 provides a hard surface for the blanket cylinder 25 to press the sheet 29 against. Each inking means 23 applies one color of ink to one side of a sheet. Thus, for multiple color printing, the sheets must go through plural inking

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means 23. To print on both sides of a sheet 29, a transfer cylinder arrangement 31 is used to effectively flip the sheet over, thus exposing its second side to subsequent blanket cylinders 25. After going through the perfecting transfer cylinder arrangement 31, the sheet then goes through additional inking means 23 that apply ink to the second side of the sheet.

After going through all of the inking means 23, the sheet exits the printing section 17 of the press by way of the delivery section 19. The delivery section removes the finished, inked sheet from the last inking means and transfer the sheet to an exit stack 33 of paper.

Referring to FIGS. 1, 2, and 7, the delivery section 19 includes plural gripper bars 35 (only one of which is shown in FIG. 1). Each gripper bar 35 includes a mounting bar 37 and plural grippers 39 mounted onto the mounting bar. The mounting bar 37 is oriented parallel to the axes of rotation of the blanket and impression cylinders 25, 27, so as to be transverse to the direction of sheet movement along the sheet path. The individual grippers 39 (only one of which is shown in FIG. 1) are positioned so as to be spaced apart from each other. The ends of the mounting bar 37 are coupled to endless chains 41, which are in turn located on sprockets 43. The sprockets 43 are mounted on a shaft 45 that is parallel to the axes of rotation of the blanket and the impression cylinders 25, 27. The sprockets 43 are located adjacent to the final inking means 23 so as to be at the exit of the blanket and impression cylinders 25, 27.

Referring to the orientation shown in FIG. 1, as the press operates, the blanket cylinder 25 rotates clockwise, the impression cylinder 27 rotates counterclockwise and the gripper bars 35 move clockwise around the shaft 45 on the sprockets 43. The movement of the gripper bars 35 is coordinated with the impression cylinder 27, which has plural grippers 47 spaced along its length. At the closest point between the path traversed by the gripper bars 35 and the impression cylinder 27, the grippers 39 of the respective gripper bar are received by the spaces between the impression cylinder grippers 47. At this point, the impression cylinder grippers 47, which have had a grip on the leading edge 49 of a sheet, open up and relinquish their grip, and the gripper bar grippers 39 close to grip the leading edge of the sheet. Thus, control of the leading edge 49 of the sheet is transferred from the impression cylinder 27 to the respective gripper bar 35. The gripper bar 35 pulls the sheet 29 clockwise around the shaft 45 and to the exit stack 33, where the grippers 39 on the gripper bar open and release the sheet. The gripper bar then travels back to the impression cylinder to grip another sheet.

The delivery apparatus 11 is mounted onto the shaft 45 so as to rotate in conjunction with the gripper bars. As the sheet 29 exits from between the blanket cylinder 25 and the impression cylinder 27, the side of sheet that is wet with ink will contact the delivery apparatus 11. The grippers 39 pull the sheet 29 around the shaft 45 to the exit stack 33. The delivery apparatus 11 reduces marring of the wet ink as the sheet 29 contact the delivery apparatus by altering the path of the sheet around the shaft so as to reduce the amount of pressure with which the sheet contacts the delivery apparatus. The sheet path is altered by providing a leading edge wall and a gap for receiving the press gripper means. The leading edge wall can be positioned, either temporarily, as in the delivery apparatus shown in FIGS. 1 and 2, or permanently, as in the delivery apparatus shown in FIGS. 3 and 4, radially inward. With the leading edge wall so positioned, the path of the sheet 29 around the shaft 45 is shortened, thereby reducing the amount of pressure with which the wet ink side of the sheet contacts the delivery apparatus. In addition, the delivery apparatus is provided with a roughened outer surface in the form of a glass-beaded film, which film enhances the non-marring aspects of the delivery apparatus.

Referring to FIGS. 1 and 2, the delivery apparatus 11 includes a main wall 55, plural support members 57, a leading edge wall 59, plural leading edge support members 61, a layer of foam 63, and a layer of film 65. The leading edge wall 59 is movable relative to the main wall 55.

The delivery apparatus 11 has two ends 67, 69 and a central axis that extends between the ends. The main wall 55 is tubular and extends between the two ends 67, 69. The main wall 55, which has outside and inside surfaces 71, 73, forms a cavity 75. The main wall 55 has a gap extending between the ends so as to form a leading edge 77 and a trailing edge 79. The main wall 55 thus describes a circular arc, with outside and inside diameters, as measured from the central axis.

The support members 57 support the main wall 55 so that the main wall retains its shape. In addition, the support members 57 are used to mount the main wall 55 to the shaft 45. The cavity 75 receives the plural support members 57 which are thick plates having generally semicircular shapes. The support members 57 are oriented transversely to the central axis and are matingly received by the inside surface 73 of the main wall 55. The support members 57 are coupled to the main wall 55 by fasteners 81 that are flush with the outside surface 71 of the main wall. The support members 57 are spaced apart from one another along the length of the main wall 55. The number and spacing of support members 57 are determined according to the size of the main wall 55, which in turn is dictated by the size of the printing press. The leading edges 83 of the respective support members 57 are aligned with the leading edge 77 of the main wall 55. The trailing edges 85 of the respective support members are spaced from the trailing edge 79 of the main wall, leaving the portion of the inside surface 71 of the main wall 55 nearest to the trailing edge 79 exposed. Each support member 57 has, near its leading edge 109, a coupling portion 87 that projects circumferentially for a short distance. The coupling portion 87 couples to the leading edge support members 61, as will be explained in more detail hereinafter. The coupling portion 87 has a first hole 89 located near the leading edge 109 of the support member 57 and a second hole 91 located near the end of the projection. The first and second holes 89, 91 receive first and second bolts 93, 95. A notch 97 for receiving the shaft 45 is formed in each support member. A semicircular locking member 99 extends across the notch 97. The locking member 99 is coupled to the support member 57 by bolts 101. The locking member has a set screw 103 and a key 105 for engaging a key slot 107 on the shaft 45.

The leading edge wall 59 is an arcuate strip that extends between the two ends 67, 69 and is positioned adjacent to the leading edge 77 of the main wall 55. The leading edge wall 59 has leading and trailing edges 109, 111 and inside and outside surfaces 113, 115. The radius of the outside surface 115 is equal to the radius of the main wall outside surface 73. The trailing edge 111 of the leading edge wall 59 is positioned adjacent to the leading edge 77 of the main wall 55. The leading edge

109 of the leading edge wall 59 projects circumferentially toward the trailing edge 79 of the main wall 55. A gap 117 is formed between the leading edge 109 of the leading edge wall 59 and the trailing edge 79 of the main wall 55.

The leading edge wall 59 is coupled to the leading edge support members 61 by way of fasteners 119 that are flush with the outside surface 115 of the leading edge wall such that the leading edge support members contact the inside surface 113 of the leading edge wall 59. Each leading edge support member 61 is pivotally coupled to a respective main wall support member 57. Each leading edge support member 61 has a first hole 121 located near the trailing edge 111 of the leading edge wall 59. The leading edge support member 61 also has an arcuate slot 123 that extends somewhat perpendicularly to the leading edge wall 59. The respective first holes 89, 121 receive the first bolt 93. The slot 123 and the second hole 91 receive the second bolt 95.

The leading edge wall 59 and the leading edge support members 61 pivot with respect to the main wall 55 about the first bolt 93 between outwardmost and inwardmost positions. In the outwardmost position, the leading edge wall 59 is extended radially outward such that its outside surface 115 lies along an imaginary arcuate extension of the outside surface 71 of the main wall 55. Thus, in the outermost position, the center of the radius of the outside surface 115 of the leading edge wall 59 is concentric to the center of the outside surface 71 of the main wall 55. The trailing edge 111 of the leading edge wall 59 is located adjacent to the leading edge 77 of the main wall 55. In the inwardmost position, the leading edge wall 59 is pivoted radially inward such that the leading edge 109 is located closer to the central axis. The outwardmost and inwardmost positions are merely the extremes of the positioning of the leading edge wall 59; the leading edge wall can be positioned at some intermediate position. The exact position is maintained by tightening the second bolt 95.

The outside surfaces 73, 115 of the main wall 55 in the leading edge wall 59 are covered in their entirety by a layer of foam material 63. The foam 63, which is resilient and flexible, is secured to the outside surfaces by a suitable adhesive. In the preferred embodiment, a one-fourth inch layer of reticulated polyurethane foam is used.

The outside surface of the foam 63 is covered in its entirety by a glass-beaded film 65. Referring to FIG. 5, the film 65 has a polyester substrate 125 which is of a highly uniform thickness. On one surface of the substrate 125, there are a myriad number of particles 127 bonded to the substrate with an oil resistive adhesive 129 (to resist oil based inks). It is believed that the particles 127, which are referred to herein as glass particles, can be made of either glass, silicon, silicone, or siliconized material. The glass particles 127 are spherical in shape and are of a uniform size. A single layer of glass particles 127 are bonded to the substrate with the density of glass particles being such that the glass particles typically contact the adjacent glass particles. The layer of adhesive is thin compared to the diameter of the glass particles; thus, there are voids 130 or spaces formed between the top surface of the adhesive and the points of contact between adjacent glass particles. The glass particles 127 are uniformly distributed over the substrate. The glass-beaded film is commercially available and has an overall uniform thickness (substrate plus glass particles) of 0.007 inches. Each glass particle has a diameter of 0.003 inches. The glass-beaded surface of the film has a smoothness of about RMS 125, compared to the outer surface of an impression cylinder, which typically has a smoothness of about RMS 63.

The film 65 is bonded to the foam 63 with a suitable adhesive such that the glass particles 127 face outwardly. The film 65 and the foam 63 extend to the ends 67, 69 of the walls and to the gap 117. The respective edges of the film 65 and the foam 63 are folded around the leading edge 109 of the leading edge wall 59 and around the trailing edge 79 of the mail wall 55, where they are clamped in place by clamping bars 131 extending parallel to the respective edges. The clamping bars 131 are retained to the respective walls by threaded fasteners 133.

The operation of the delivery apparatus 11 will now be described. The delivery apparatus 11 can be easily retrofitted into existing presses or installed in new presses. The delivery apparatus 11 is mounted onto the gripper bar sprocket shaft 45, between the two sprockets 43. To install, the locking members 99 are removed from the respective support member 57 and the delivery apparatus is mounted onto the shaft 45 such that the shaft is matingly received into the notches 97 of each of the support members. Then, the locking members 99 are installed onto the shaft, and coupled to the respective support members 57 by the bolts 101. The set screws 103 are tightened to set the respective keys 105 into the shaft key slot 107. Access to the bolts 101, 93, 95 and the set screw 103 is through the gap 117. When the delivery apparatus is installed onto the shaft 45, the respective gripper bars 35 are received by the gap 117 as the gripper bars go around the shaft on the sprockets 43. When the leading edge wall 59 is in the outermost position, the outside diameter of the delivery apparatus 11 is equal to the outside diameter of the impression cylinder 27. When the delivery apparatus 11 is installed on the shaft 45, the grippers 39 of the gripper bar 35 are in proximity to the leading edge 109 of the leading edge wall 59.

After the delivery apparatus 11 is installed in the press, the leading edge wall 59 is pivoted and set in the appropriate position by the press operator. The appropriate position is determined by the length of the sheets 29 which are to pass through the printing press in a print run. For short sheets 29 (see FIG. 1), the leading edge wall 59 can be in any position, but is preferably set in an outward position. For long sheets 29A, (see FIG. 1A) the leading edge wall 59 is set in an inward position.

Marring of wet ink occurs when the wet ink contacts some surface and there is a relatively large amount of force or pressure between the sheet and the surface. In the printing press, both the leading edge 49 and the trailing edge portion 51 of the sheet are retained by the printing press. The leading edge 49 of the sheet is retained by the grippers 39 of the gripper bar 35, while the trailing edge portion 51 is pinched at a pinch point (or nip) P between the blanket and impression cylinders 25, 27. As the grippers pull the sheet 29, the trailing edge 51 of the sheet will eventually be pulled free of the pinch point P. For short sheets 29, the trailing edge 51 will be pulled free soon after the grippers 39 have gripped the leading edge 49. For long sheets 29A, the trailing edge will be pulled free when the gripper bar 35 has rounded the shaft 45. Any surface that contacts the sheet 29 intermediate the grippers 39 and the pinch point P will deform the sheet and tension the sheet. Thus, the outer surface of the impression cylinder 27 causes the sheet to deflect in one direction, while the outer surface of the

delivery apparatus 11 causes the sheet to deflect in the other direction, forming the sheet into an "S" shape as shown in FIG. 1. The greater the deformation of the sheet away from a straight line intersecting the pinch point P and the grippers 39, the greater the amount of force exerted by the sheet against the deforming surfaces.

In order to reduce marring of wet ink, the delivery apparatus 11 shortens the sheet path in order to reduce the deformation of the sheet and thus reduce the pressure of the sheet against the deforming surfaces. For a short sheet 29, where as shown in FIG. 1, the trailing edge portion 51 of the sheet quickly passes through the pinch point P between the blanket and impression cylinders, pressure of the sheet against the impression cylinder 27 and the delivery apparatus 11 is quickly relieved. Thus, pressure of the sheet against the delivery apparatus and the impression cylinder is short-lived. The leading edge wall 59 is typically set in the outwardmost position in order to retain some control over the sheet; it is believed that setting the leading edge wall 59 in the outermost position will prevent undue bumping of the sheet 29 against the delivery apparatus 11. However, the leading edge wall 59 could be set further inward if desired, without marring the ink.

For a long sheet 29A, as shown in FIG. 1A, the trailing edge portion 51 of the sheet is retained for a much longer period of time. The leading edge wall 59 is positioned in its inwardmost position to reduce sheet deformation. As shown in FIG. 1A, the inwardmost position of the leading edge wall 59 greatly reduces the deformation of the sheet 29A, which reduces the amount of pressure of the sheet against the impression cylinder 27 and the delivery apparatus 11, which in turn reduces marring of the sheet. As the gripper bar 35 rotates clockwise around the shaft 45 toward the exit stack 33, the delivery apparatus will deform the sheet somewhat. But, the pressure of the sheet 29A outside surface of the delivery apparatus, distributing the pressure over the larger area. As the gripper bar 35 continues to move toward the exit stack 33, the grippers 39 will pull the trailing edge 51 of the sheet free from the pinch point P.

The length of the leading edge wall 59, as measured from the trailing edge 111 to the leading edge 109 ideally should be made as large as possible to allow an operator to maximize the reduction of sheet deformation by shortening the sheet path to a maximum extent. This length is limited by the shaft 45 however, which becomes an obstacle to inward movement if the leading edge wall is made too long.

The press operator may take the relative positions between the blanket cylinder 25, the impression cylinder 27, and the delivery apparatus 11 into consideration when adjusting the position of the leading edge wall 59. In FIG. 1, imaginary lines through points X and Y and through Y and Z, which points are the respective axes of rotation, describe an angle that is about 90 degrees. In some taller presses, the blanket cylinder 25 is located physically higher with respect to the delivery apparatus 11, thus making the angle XYZ greater than 90 degrees. The practical consequence of this larger angle is that the pinch point P between the blanket and impression cylinders is raised, wherein the trailing edge portion 51 of the sheet is released earlier in time than for the press of FIG. 1. Thus, in a taller press, a larger sheet may be released earlier from the pinch point, wherein the leading edge wall 59 can be positioned slightly more outwardly than for a shorter press.

The foam layer 63 on the delivery apparatus further acts to reduce the pressure between the sheet 29 and the delivery apparatus 11 by providing some compressibility to the delivery apparatus outside surface. The foam will compress under pressure from the sheet.

The glass-beaded film 65 enhances the non-marring capabilities of the delivery apparatus. The glass-beaded film 65 provides a somewhat roughened surface to contact the wet ink on the sheet. The roughened surface has rounded projections in the form of the glass spheres 127. The voids between the glass spheres receives some of the wet ink. The film can be cleaned using commercially available solvents which are normally used to clean the ink from printing presses. The glass-beaded film 65 can be easily replaced as needed. The old film is simply peeled off and new film is glued back on. The foam 63 can also be replaced as required.

The impression cylinder 27 is also provided with a covering of the glass-beaded film 65. In perfecting presses, after the sheet has gone through the transfer cylinder arrangement 31 (see FIG. 7), the sheet has wet ink against subsequent impression cylinders. The force of the blanket cylinder 25 forces the sheet against the impression cylinder 27; the wet ink acts as a lubricant and causes the sheet to move or jiggle when being printed on by the blanket cylinder. This movement destroys the registry of the press. Registry is important for multicolored printing and requires the sheet to be precisely positioned to allow for accurate inking. Use of the glass-beaded film 65 on impression cylinders improves the registry of the press when wet ink is against the respective impression cylinder and minimizes marring in the wet ink.

In FIG. 6, there is shown a delivery apparatus 141 in accordance with another embodiment. The delivery apparatus includes plural segments 143 mounted onto the shaft 45A in a spaced apart fashion. Instead of one delivery apparatus 11 that extends to both sprockets 43A, the segments 143 are narrow, being separated from one another by spaces. Each segment 143 is similar to the delivery apparatus 11 of FIGS. 1 and 2. Each segment has a main wall 55A, a support member 57A, a leading edge wall 59A, and a leading edge wall support member 61A. The leading edge walls 59A of the segments 143 can be pivoted between an outwardmost position and an inwardmost position. The respective leading edge walls 59A are individually pivoted to the desired position. The segments 143 can be positioned along the shaft 45 to those areas of the sheet path requiring support of the sheet. A layer of foam 63 and glass-beaded film 65 are provided on each segment 143.

Referring to FIGS. 3 and 4, a delivery apparatus 151 in accordance with another embodiment will be described. The delivery apparatus 151 has at least one leading edge 173 that is fixed in a radially inward position. The wall 165 tapers from the leading edge to the central portion of the wall to shorten the sheet path around the shaft 153. The delivery apparatus 151 is useful for small sheet-fed offset lithographic printing presses where, for space limitations, the diameter of the delivery apparatus must be smaller than the diameter of the final impression cylinder. This is due to the gripper bar sprocket shaft 153 being positioned close in to the impression cylinder 155.

The small press is similar to the larger press shown in FIGS. 1 and 2, and has a blanket cylinder 157 and an impression cylinder 155. Plural gripper bars 159 are coupled to the chains 161 in an orientation which is

transverse to the direction of sheet travel. The chains 161 are mounted on sprockets 163 which in turn are mounted onto the shaft 153. The diameter of the sprockets 163 is one-half of the diameter of the impression cylinder 155. Therefore, the shaft 153 is positioned close to the outside surface of the impression cylinder 155.

Because of the close position of the shaft 153 to the impression cylinder 155, the delivery apparatus 151 must have a smaller diameter than the impression cylinder 155. The delivery apparatus 151 has two main walls 165 that each extend between first and second ends. The delivery apparatus 151 is provided with two gaps 167 between the main walls 165 that receive the gripper bars 159. In the preferred embodiment, two gaps 167 are provided instead of just a single gap to ensure that the gripper bars are always received by a gap. Thus, successive gripper bars are received by alternating gaps 167. However, if a press and the gripper bars would allow it, the delivery apparatus could be made with just one gap, as described above with reference to FIGS. 1 and 2.

The main walls 165 which are substantially similar to each other, are arcuate, having the same radius. The main walls 165 have inside and outside surfaces 169, 171 and leading and trailing edges 173, 175. Plural support bars 177 couple the main walls 165 together. The ends 179 of the support bars 177 contact the inside surfaces 169 of the respective main walls 165 in such a manner as to be centered between the respective edges 173, 175. The support bars have respective notches 181 for receiving the shaft 153, and respective locking members 183 for locking the shaft in the notches 181.

The length of the support bars 177 as measured between their ends 179, is greater than twice the radius of the main walls 165. Thus, the main walls 165 are mounted with respect to each other such that the distance between their centers 185 is greater than twice their radius. This effectively causes the edges 173, 175 to be positioned radially inward from the centers 185 of the main walls 165. For example, in the preferred embodiment, the main walls 165 are cut from a three and one-half inch outside diameter tube and mounted onto support bars 177 which are four inches in length. At the center 185 of each main wall 165, the inside surface 169 of the main wall is two inches from the center line of the shaft 153. At the edges 173, 175 of each main wall 165, the inside surface 169 is less than two inches from the center line of the shaft.

The main walls 165 are each covered by a layer of foam 63 and glass-beaded film 65, which are glued on using a suitable adhesive.

The delivery apparatus 151 is mounted onto the shaft 153 such that the gripper bars 159 are received by the gaps 167. The gripper bar 159 pulls the sheet 29 around the shaft 153 to the exit stack. As the sheet 29 moves off of the impression cylinder 155, wet ink is against the delivery apparatus 151. The leading edge 173 of the main wall 165 that first contacts the sheet is located radially inward, thus shortening the sheet path and reducing pressure between the sheet and the main wall. The sheet is transferred to the exit stack by the respective gripper bar, with no marring. The foam 63 and the glass-beaded film 65 act to reduce marring of the wet ink as described above.

The foregoing disclosure and the showings made in the drawings are merely illustrative of the principles of this invention and are not to be interpreted in a limiting sense.

We claim:

1. A delivery apparatus for use in a sheet-fed printing press, said printing press having inking means for providing an application of ink to a sheet, and having gripper means for gripping a leading edge of said sheet as said sheet exits from said inking means, comprising:

a) main wall means having first and second ends and a central axis extending between said ends, said main wall means being arcuate;

b) said main wall means having a gap extending between said first and second ends, said gap forming leading and trailing edges on said main wall means;

c) leading edge wall means having a trailing edge and a leading edge, said leading edge wall means being located in said gap and being moveably coupled to said main wall means such that said trailing edge of said leading edge wall means is adjacent to said leading edge of said main wall means, said leading edge wall means forming a smaller gap between said leading edge of said leading edge wall means and said trailing edge of said main wall means;

d) said main wall means and said leading edge wall means having respective outside surface portions that form an outside surface, said outside surface having a myriad of minute projections projecting radially outward, said projections having rounded outer ends;

e) said leading edge wall means being movable between innermost and outermost positions, such that with said leading edge wall means being in said outermost position said leading edge of said leading edge wall means is further away from said central axis than said leading edge of said leading edge wall means when said leading edge wall means is in said innermost position;

f) said main wall means being adapted to be rotatably mounted to said press adjacent to the exit of said inking means, said smaller gap being adapted to receive said gripper means when said gripper means grips the leading edge of said sheet, whereby said leading edge wall means is adapted to contact the portion of said sheet adjacent to said sheet leading edge.

2. The delivery apparatus of claim 1 wherein:

a) said main wall means and said leading edge wall means further comprise a layer of flexible and resilient foam material;

b) said outer surface being provided by a layer of film means, said film means comprising a substrate bonded to said foam material and a myriad of minute particles bonded to said substrate with an oil resistive adhesive, said particles being spherical in shape and of uniform size.

3. The delivery apparatus of claim 1 wherein said leading edge wall means is pivotally coupled to said main wall means at a point located near said trailing edge of said leading edge wall means such that said leading edge of said leading edge wall pivots radially in and out.

4. The delivery apparatus of claim 2 wherein said leading edge wall means is pivotally coupled to said main wall means at a point located near said trailing edge of said leading edge wall means such that said leading edge of said leading edge wall pivots radially in and out.

5. The delivery apparatus of claim 1 wherein said outer surface is provided by a film means, said film means comprising a substrate and a myriad of minute particles bonded to said substrate with an oil resistive

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adhesive, said particles being spherical in shape and of uniform size.

6. A delivery apparatus for use in a sheet-fed printing press, said printing press having inking means for providing an application of ink to a sheet, and having gripper means for gripping a leading edge of said sheet as said sheet exits from said inking means, comprising:

a) main wall means having first and second ends and a central axis extending between said ends, said main wall means being tubular having an interior cavity;

b) said main wall means having a gap extending between said first and second ends, said gap forming leading and trailing edges on said main wall means, said gap allowing access to said interior cavity;

c) support means for supporting said main wall means, said support means being located in said cavity and coupled to said main wall means, said support means being adapted to be rotatably mounted to said press adjacent to the exit of said inking means;

d) leading edge wall means having a leading edge and a trailing edge, said leading edge wall means being located in said gap and being coupled with said main wall means such that said trailing edge of said leading edge wall means is adjacent to said leading edge of said main wall means, said leading edge wall means forming a smaller gap between said leading edge of said leading edge wall means and said trailing edge of said main wall means;

e) said leading edge wall means being pivotable with respect to said main wall means such that said leading edge of said leading edge wall means pivots between innermost and outermost positions, retaining means for retaining the position of said leading edge wall means, said retaining means allowing for the pivoting adjustment of said leading edge wall means;

f) said main wall means and said leading edge wall means having respective outside surface portions that form an outside surface, said outside surface having a myriad of minute projections projecting radially outward, said projections having rounded outer ends;

g) said smaller gap being adapted to receive said gripper means when said gripper means grips the leading edge of said sheet when said support means is rotatably mounted to said press.

7. The delivery apparatus of claim 6 wherein:

a) said main wall means and said leading edge wall means further comprise a layer of flexible and resilient foam material;

b) said outer surface being provided by a layer of film means, said film means comprising a substrate bonded to said foam material and a myriad of minute glass particles bonded to said substrate with an oil resistive adhesive, said glass particles being spherical in shape and of uniform size.

8. A delivery apparatus for use in a sheet-fed printing press, said printing press having inking means for providing an application of ink to a sheet, and having gripper means for gripping a leading edge of said sheet as said sheet exits from said inking means, comprising:

(a) plural segments adapted to be rotatably mounted to said press adjacent to the exit of said inking means such that said segments are located along a line oriented transversely to said leading edge of said sheet;

(b) each of said segments having a main wall means, said main wall means having a leading edge and a trailing edge and a gap formed between said leading and trailing edges;

c) each of said segments having a leading edge wall means having a trailing edge and a leading edge, said leading edge wall means being located in said gap and being moveably coupled to said main wall means such that said trailing edge of said leading edge wall means is adjacent to said leading edge of said main wall means, said leading edge wall means forming a smaller gap between said leading edge of said leading edge wall means and said trailing edge of said main wall means;

d) for each of said segments said main wall means and said leading edge wall means having respective outside surface portions that form an outside surface, said outside surface being arcuate from said trailing edge of said main wall means to said leading edge of said leading edge wall means, said outside surface having a myriad of minute projections projecting radially outward, said projections having rounded outer ends;

e) for each of said segments said leading edge wall means being movable between innermost and outermost positions, such that with said leading edge wall means being in said outermost position said leading edge of said leading edge wall means is further away from said central axis than said leading edge of said leading edge wall means when said leading edge wall means is in said innermost position;

f) for each of said segments said main wall means being adapted to be rotatably mounted to said press adjacent to the exit of said inking means, said smaller gap being adapted to receive said gripper means when said gripper means grips the leading edge of said sheet, whereby said leading edge wall means is adapted to contact the portion of said sheet adjacent to said sheet leading edge.

9. The delivery apparatus of claim 8 wherein:

a) for each of said segments said main wall means and said leading edge wall means further comprise a layer of flexible and resilient foam material;

b) said outer surface on each of said segments being provided by a layer of film means, said film means comprising a substrate bonded to said foam material and a myriad of minute particles bonded to said substrate with an oil resistive adhesive, said particles being spherical in shape and uniform in size.

10. The delivery apparatus of claim 9 wherein for each of said segments said leading edge wall means is pivotally coupled to said main wall means at a point located near said trailing edge of said leading edge wall means such that said leading edge of said leading edge wall means pivots radially in and out.

11. A delivery apparatus for use in a sheet-fed printing press, said printing press having inking means for providing an application of ink to a sheet, and having gripper means for gripping a leading edge of said sheet as said sheet exits from said inking means, comprising:

(a) wall means having first and second ends and a central axis extending between said ends, said wall means being arcuate;

(b) said wall means having a gap extending between said first and second ends, said wall means having a leading edge and a trailing edge and a central portion located between said leading and trailing

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edges, said gap allowing access to a cavity inside of said wall means;

(c) support means for supporting said wall means, said support means being located in said cavity and coupled to said wall means such that said leading edge of said wall means is located closer to said central axis than is said central portion, said support means being adapted to be rotatably mounted to said press adjacent to the exit of said inking means;

(d) said wall means having an outside surface, said outside surface having a myriad of minute projections projecting radially outward, said projections having rounded outer ends;

(e) said gap being adapted to receive said gripper means when said gripper means grips the leading edge of said sheet when said delivery apparatus is mounted to said press;

(f) said wall means further comprising a layer of flexible and resilient foam material;

(g) said outer surface being provided by a layer of film means, said film means comprising a substrate bonded to said foam material and a myriad of minute particles bonded to said substrate with an oil resistive adhesive, said particles being spherical in shape and uniform in size;

(h) said gap being a first gap, said wall means having a second gap, said gaps dividing said wall means into two portions with each wall means portion having a leading edge and a trailing edge and a central portion, said respective leading edges being located closer to said central axis than said respective central portions;

(i) each of said wall means portions has a first radius, said support means has ends that couple to said wall means portions, said support means has a second radius as measured from the central axis to one of said ends of said support means, said second radius being greater than said first radius.

12. A sheet-fed printing press, comprising:

(a) inking means for providing an application of ink to a sheet of paper;

(b) gripper means for gripping a leading edge of said sheet as said sheet exits from said inking means, said gripper means rotating about a shaft positioned in proximity with the exit of said inking means;

(c) wall means having first and second ends and a central axis extending between said ends, said wall means being arcuate;

(d) said wall means having first and second gaps extending between said first and second ends, said gaps dividing said wall means into two portions, with each wall means portion having a leading edge and a trailing edge and a central portion located between said leading and trailing edges, said gaps allowing access to a cavity inside of said wall means, each of said wall means portions having a first radius;

(e) support means for supporting said wall means portions, said support means being located in said cavity and coupled to said wall means portions, said support means having a length extending between said wall means portions, said support means length being greater than twice the first radius of said wall means portions such that said leading edges of said wall means portions are located closer to said central axis than are said respective central portions, said support means being coupled to said shaft so as to rotate with said shaft such that said gaps receive said gripper means when said gripper means grips the leading edge of said sheet;

(f) said wall means portions having respective outside surfaces, said outside surfaces having a myriad minute projections projecting radially outward, said projections having rounded outer ends.

13. The delivery apparatus of claim 8 wherein each of said outside surfaces is provided by a film means, said film means comprising a substrate and a myriad of minute particles bonded to said substrate with an oil resistive adhesive, said particles being spherical in shape and of uniform size.

14. A delivery apparatus for use in a sheet fed printing press, said printing press having inking means for providing an application of ink to a sheet, and having gripper means for gripping a leading edge of said sheet as said sheet exits from said inking means, comprising:

(a) wall means having first and second ends and a central axis extending between said ends, said wall means being generally arcuate;

(b) said wall means having a leading edge portion, said wall means having a gap that extends between said first and second ends, said gap being between said leading edge portion and a trailing edge of said wall means, said gap being adapted to receive said gripper means as said gripper means grips the leading edge of said sheet when said delivery apparatus is mounted to said press;

(c) said leading edge portion of said wall means being positioned closer to said central axis than a non-leading edge portion of said wall means;

(d) said wall means having an outside surface that is adapted to contact said sheet when said sheet is being pulled by said gripper means, said outside surface being ink resistive wherein marring of wet ink on said sheet, which wet ink is in contact with said outside surface, is reduced;

(e) said leading edge portion being movable with respect to the non-leading edge portion of said wall means, said leading edge portion being movable between innermost and outermost positions such that when said leading edge portion is in said outermost position said leading edge portion is further away from said central axis than when said leading edge portion is in said innermost position.

15. The delivery apparatus of claim 14 wherein said outside surface is provided by replaceable film means.

16. The delivery apparatus of claim 14 wherein said outside surface is provided by replaceable film means, said wall means further comprising a layer of flexible and resilient foam material, said film means being coupled to said foam material, said foam material being coupled to a support wall of said wall means.

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US005107790A

United States Patent [19]

Sliker et al.

[11] **Patent Number: 5,107,790**

[45] **Date of Patent: Apr. 28, 1992**

[54] **TWO HEADED COATER**

[75] Inventors: **Larry J. Sliker**, Livonia; **Robert S. Conklin**, Rochester, both of N.Y.

[73] Assignee: **Rapidac Machine Corp.**, Rochester, N.Y.

[21] Appl. No.: **463,115**

[22] Filed: **Jan. 11, 1990**

[51] Int. Cl.^{5} **B05C 1/08; B05C 11/00**

[52] U.S. Cl. **118/674**; 118/46; 118/212; 118/249; 118/255; 118/258; 118/262

[58] Field of Search .... 118/674, 46, 249, 255, 118/258, 262, DIG. 1; 101/247, 329, 352

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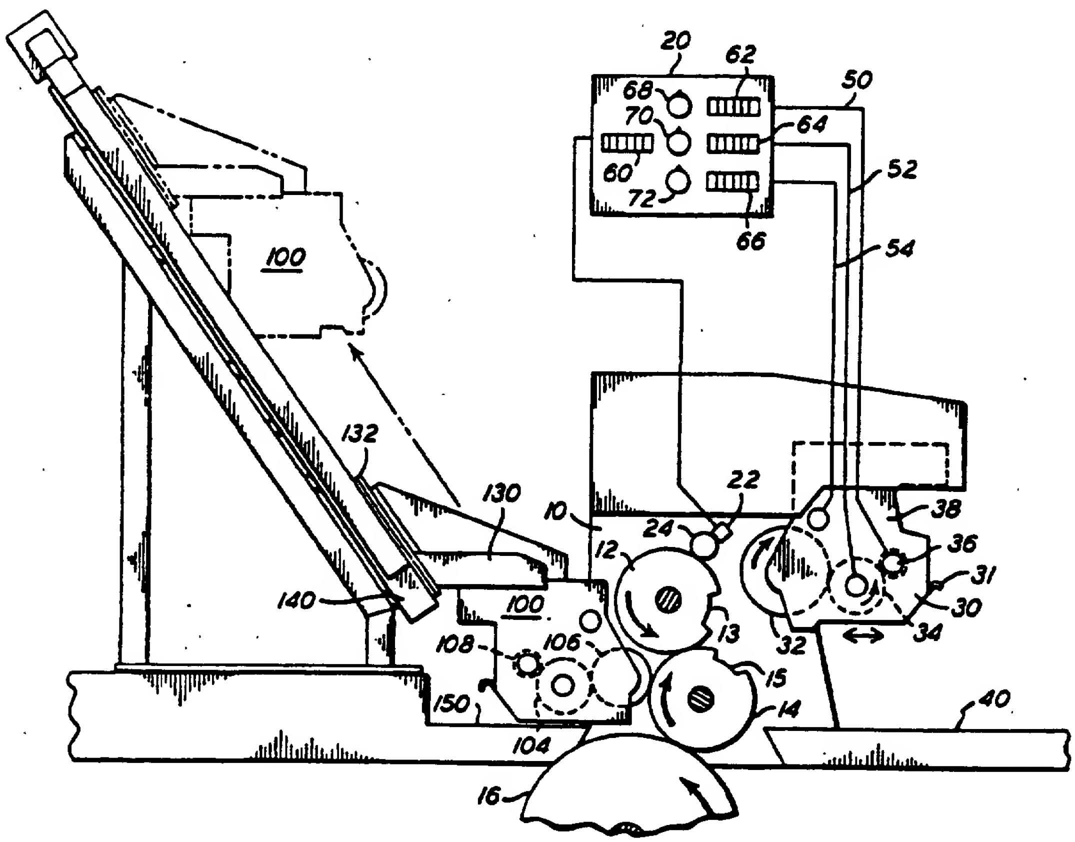
Primary Examiner—Michael G. Wityshyn
Attorney, Agent, or Firm—Cumpston & Shaw

[57] **ABSTRACT**

Coating apparatus for applying continuous or spot coatings to an image printed surface includes a plate cylinder; a blanket cylinder for transferring a coating material from the plate cylinder to the copies; a blanket coating roller for transferring a continuous layer of coating material to the blanket cylinder; a plate coating roller for selectively applying spot coating material to the plate cylinder; a first retractor for moving the blanket coating roller laterally into and out of transferring engagement with the blanket cylinder; and a second retractor for moving the plate coating roller into and out of transferring engagement with the plate cylinder.

14 Claims, 3 Drawing Sheets



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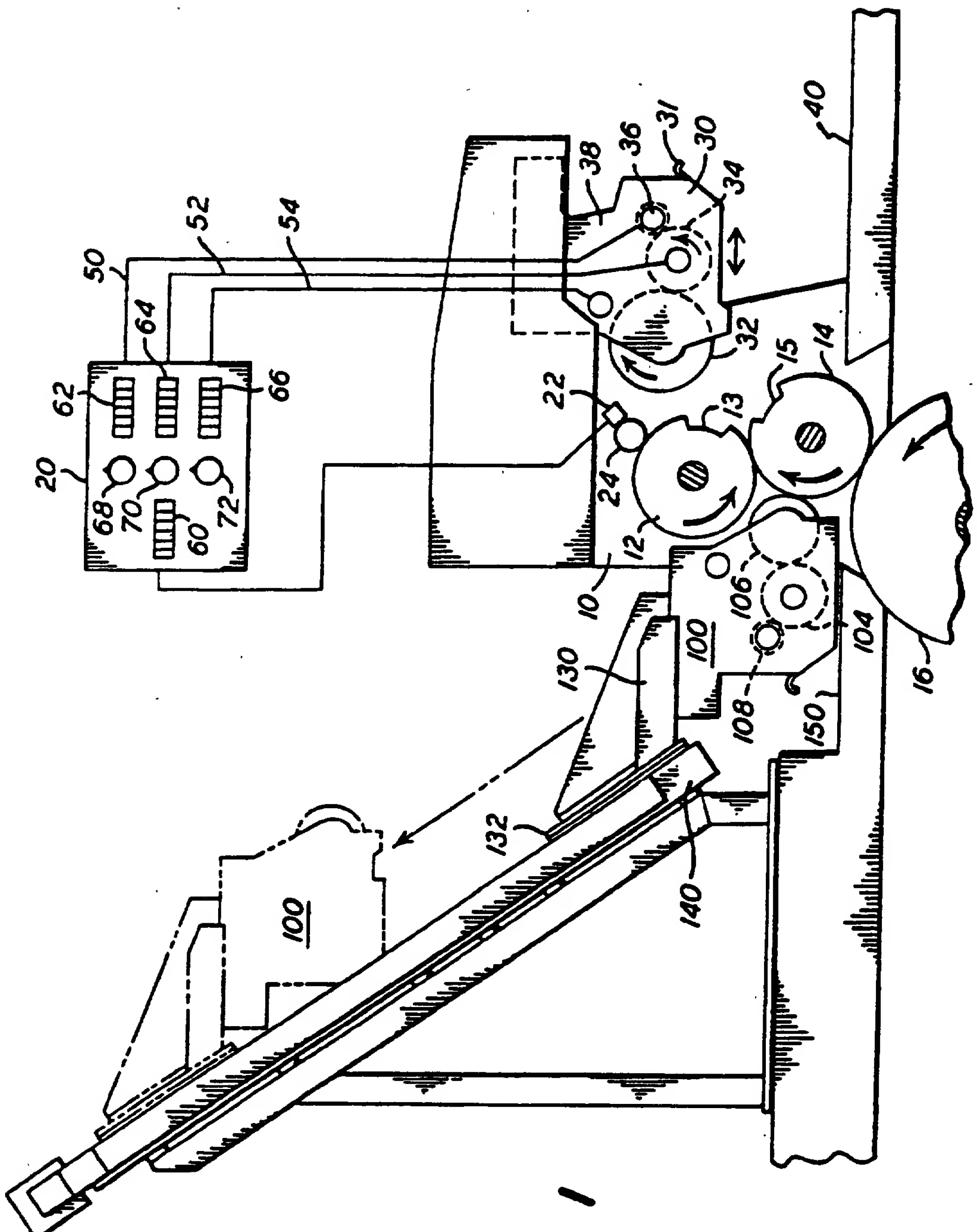

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FIG. 1

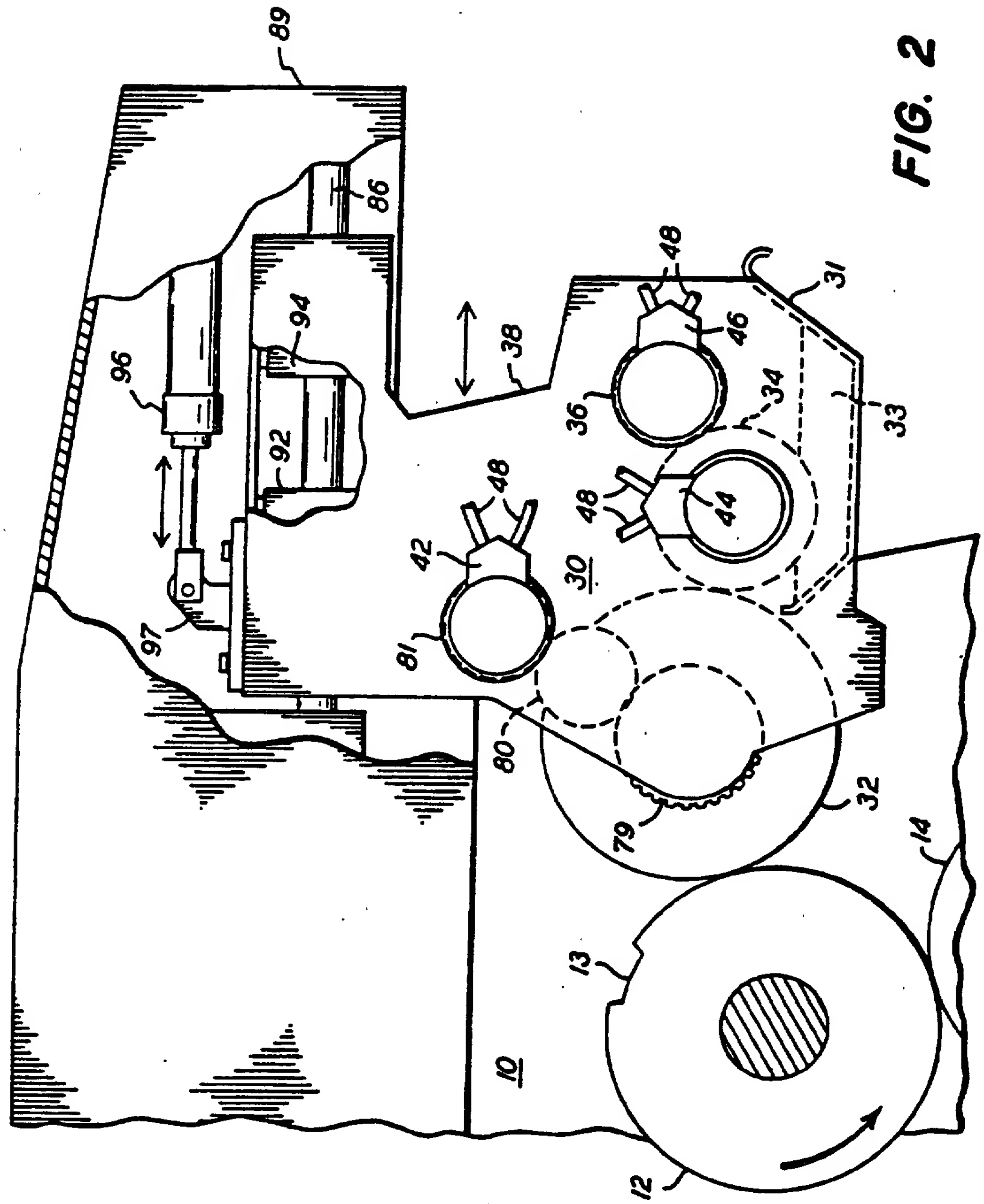
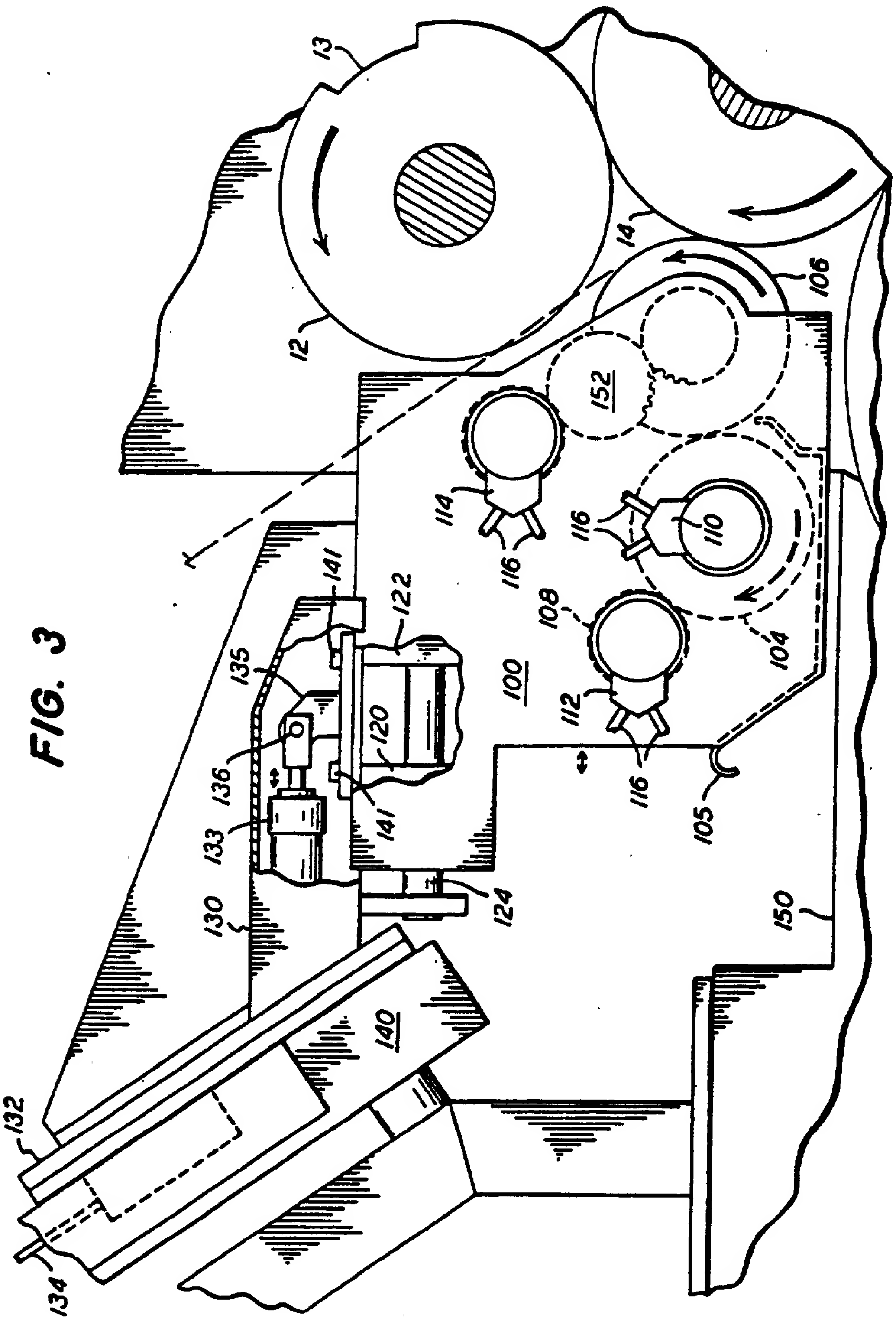


FIG. 2

FIG. 3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TWO HEADED COATER

This invention relates in general to coating apparatus for printing presses, and more particularly to a dual headed coater adapted to provide overall or spot coating on a printed sheet or web as a final or near final step in the printing process.

The advantages of coating printed sheets are well known, and much effort has been expended in providing satisfactory apparatus for carrying out the coating process. Among the many patents relating to coating apparatus are U.S. Pat. Nos. 4,615,293, 4,569,306, 4,685,414, 4,446,814, 4,421,027, 4,399,767, 4,397,237, 4,308,796, 4,270,483, and 3,931,791.

For flexibility and to reduce costs, printing presses are often assembled from a plurality of substantially identical printing units, the number of units used being determined by the number of colors to be printed. Each printing unit applies a different color ink to the sheet or web to form the printed image. It is advantageous, to reduce costs, and maintain flexibility in adapting the press to different jobs, to provide coating apparatus that may be selectively engaged with the plate or blanket cylinders of an existing printing unit to carry out the coating operation and disengaged so that the printing unit can be used for its normal purpose or allowed to idle when coating is not required.

Among the patents mentioned above, Jahn U.S. Pat. No. 4,615,293 shows a medium applicator for a printing machine. The medium applicator (coater) is disposed downstream of the printing units of the machine, and includes two applicator rollers, one contacting the roller that would function as the plate roller in a conventional printing unit and the other contacting the blanket cylinder. The coating rollers are disposed on the upstream side of the plate and blanket cylinders respectively of the coating assembly.

Although the coating apparatus described in the Jahn patent is theoretically capable of carrying out the spot and blanket coating operations as described, in practice, the arrangement shown in the Jahn patent is impractical, and would be of little use in a large scale printing application.

Printers can produce high volumes of printed material rapidly through the use of modern printing presses. The presses are extremely expensive, and the amount of time required to reconfigure the press from one job to another is non-productive, and costly. Accordingly, there is a need for presses and associated coating apparatus that minimize the time required to clean up from one run, and set up and commence the next run. Although versatile coaters that can apply spot and blanket coatings are desirable, ordinarily only one coater at a time is actually in operation. Where consecutive jobs require the same sort of coating, particularly blanket coating, it may not be necessary to clean up the coater between jobs. However, the coating lacquers cannot be allowed to dry on the rollers, and therefore, especially when switching from blanket to spot coating or vice-versa, or if there is a wait between jobs, it is necessary to clean up the coaters after each job is completed. In addition, cleanup is necessary when switching between different coating compositions, such as aqueous and u-v coatings. Such coatings are incompatible, and the coaters must be cleaned between applications of such different coatings.

Modern high speed printing presses are dangerous to work around in ordinary circumstances, and are particularly dangerous when operating at full speed. It would be virtually impossible to clean the prior art coaters such as the coater shown in the Jahn patent while the press is operating, and especially difficult for example to clean the blanket coater while printing spot coatings on a subsequent job.

Accordingly, it is an object of this invention to provide coating apparatus for applying continuous or spot coatings to an image printed surface comprising: a plate cylinder; a blanket cylinder for transferring a coating material from the plate cylinder to the copies; a blanket coating roller for transferring a continuous layer of coating material to the blanket cylinder; a plate coating roller for selectively applying spot coating material to the plate cylinder; first retracting means for moving the blanket coating roller laterally into and out of transferring engagement with the blanket cylinder; and second retracting means for moving the plate coating roller into and out of transferring engagement with the plate cylinder.

It is another object of this invention to provide coating apparatus of the type described and further including tachometer or other means responsive to the rotation of the plate and blanket cylinders for providing speed signals proportional to the press speed and control means responsive to the speed signals for controlling the speed of the plate and blanket coating rollers.

It is another object of this invention to provide drive means for the plate and blanket coating rollers, and independent controllers for each of the drive means permitting the relative speeds of the plate and blanket coating rollers and plate and blanket cylinders respectively, to be continuously controlled to adjust the shear at the nip between the rollers and the cylinders at various press speeds for enhancing the coating operation.

It is still another object of this invention to provide a retracting assembly for moving one of the plate and blanket coating rollers horizontally into and out of engagement with one of the plate and blanket cylinders, and for lifting the coating roller assembly away from the cylinder for easy access during cleaning.

It is still another object of this invention to provide means for translating the other coating roller into and out of engagement with the other cylinder, the out of engagement position adapted to permit cleaning of the roller and associated apparatus.

It is a still further object of this invention to provide control means responsive to sensing tachometers or other means providing signals proportioned to press speed coupled to the plate and blanket cylinders for controlling the rotation of the coating rollers and associated pick up and metering rollers for controlling the amount of coating material applied to the printed page.

It is a still further object of this invention to provide control means for incrementally adjusting the relative speed of the pickup, metering, and coating rollers relative to the speed of the plate and blanket cylinders.

It is a feature of this invention that coating rollers can be employed, because of the placement thereof on opposite sides of the press unit, that are larger in diameter than those utilized in prior art coaters. The use of large diameter coating rollers reduces the speed of rotation of the rollers, and thereby the tendency of the rollers to sling coating material off the surface by centrifugal force. This is especially advantageous in pattern or spotting coating operations, where the surface speeds of

the applicator roller and plate cylinder must be the same. The use of larger rollers reduces the centrifugal force produced at the surface of the applicator roller, thus greatly reducing the slinging or misting of coating material, when the present invention is employed. Slinging or misting of coating material greatly increases the difficulty of cleanup after a coating operation.

While the novel aspects of the invention are set forth with particularity in the appended claims, the invention itself, together with further objects and advantages thereof, may be more readily understood by reference to the following detailed description of the invention, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevation of a two headed coater in accordance with this invention;

FIG. 2 is an enlarged segmental side elevation of the plate coating assembly of the two headed coater of FIG. 1; and

FIG. 3 is a segmental side elevation of the blanket coating assembly of the two headed coater of FIG. 1.

Referring now to FIG. 1, a simplified view of a printing unit, preferably the last unit, of a multi-stage offset printing press is illustrated with the coating apparatus of the invention operatively associated therewith. The coating apparatus of this invention is specially adapted to allow it to be retrofitted to a variety of printing units, either during manufacture, or after a press has been installed in a print shop. The damping and inking systems employed in a conventional printing unit are not shown. They may be omitted if the coating unit is designed solely for coating, removed, or simply disengaged or not used in a printing unit retrofitted for coating in accordance with this invention. The unique construction of the two headed coater of this invention permits the coating rollers to be moved into contact with the plate cylinder and blanket cylinder of the converted printing unit, and to be withdrawn to accessible positions for cleaning when not in use.

Printing unit 10 includes a plate cylinder 12 and a counter rotating blanket cylinder 14. As used herein, plate and blanket cylinder refer to the assemblies including plates and blankets, and associated clamps and the like, that are disposed in recesses 13 and 15 shown schematically in the drawing for simplicity. Blanket cylinder 14 contacts an impression cylinder 16 under some pressure and the printed sheet is normally passed through the nip between the blanket and the impression cylinders in a manner well understood by those skilled in the art. Conventional drive means, including cylinder gear wheels, a main driver motor and associated controls, not shown, synchronize the rotation of the plate cylinder, blanket cylinder, and impression cylinder, with the rest of the press.

A controller 20 continuously monitors the press speed through the use of a speed sensor, such as tachometer 22, which may be an optical encoder having a wheel 24 arranged to bear against the plate cylinder (or the blanket cylinder if it is more accessible) for providing a continuous speed signal to controller 20. As used herein, the term tachometer is intended to encompass any device that provides a signal from which the relative speed of the press may be determined. Many presses incorporate such devices internally, and the outputs from internal tachometers of whatever sort are often suitable as speed signals for the coaters of the present invention.

Turning now to the spot coater assembly of the invention, the assembly 30 includes a coating roller 32, a pick up roller 34, and a metering roller 36, all journalled in a conventional fashion in a laterally translatable frame 38 as will be more fully described in connection with FIG. 2.

Referring to FIG. 2, pickup roller 34 is adapted to be at least partially immersed in a container 31 of coating material, such as lacquer 33. The container is omitted from FIG. 1 of the drawing, so as not to obscure the remaining elements. Pick up roller 34 rotates counter clockwise, and metering roller 36, by virtue of the spacing at the nip and the relative speed thereof with respect to the pickup roller, controls the amount of coating material transferred to the coating roller 32 from pickup roller 34. Spot coating assembly 30 is shown in its retracted position in FIG. 1. In this position the assembly is accessible for cleaning, even while the press is running. To this end, a work space is provided adjacent to the coating assembly on a platform 40 on which an operator may stand, to gain access to the spot coating assembly for service and cleaning.

Referring now to FIG. 2, the spot coater 30 is shown in its operating position with coating roller 32 engaging plate cylinder 12. Each of the rollers 32, 34, and 36 of the spot coating assembly 30 is driven by a separate hydraulic motor 42, 44 and 46 respectively. Conventional hydraulic lines 48 convey pressurized hydraulic fluid from a pump and controller valves to the motors and provide for a return to the pump (not shown). The control valves are connected to controller 20. A speed sensor is provided on each of hydraulic motors 42, 44 and 46. The speed sensors are connected to controller 20 via sensing lines 50, 52 and 54. Controller 20 preferably includes conventional displays such as digital for the press speed 60, metering roller speed 62, pickup roller speed 64, and plate coating roller speed 66. The speed of each of the metering, pickup and coating rollers is adjustable by means of controls 68, 70 and 72 respectively that are coupled to the controller valves. In addition, controller 20 is responsive to the press speed as sensed by tachometer 22 for correspondingly increasing or decreasing the speeds of the motors driving pickup, metering and coating rollers, so as to maintain synchronization with the press. It will be understood that synchronization does not necessarily mean that all of the rollers are driven in such a manner as to provide zero slip (relative speed) at the nips, but rather that the desired conditions, which may include relative shear at the nips, are maintained as the press speed is increased. In accordance with a presently preferred embodiment of the invention, the relative speeds of the rollers are set while the press is running at a low speed, and the controller 20 adjusts the speeds of the motors driving the pickup, metering and coating rollers, to maintain the same relative speed as the press speed increases. By adjusting controls 68, 70 and 72, the relative speeds may be fine tuned at any press speed.

As shown in FIG. 2, pickup roller 34 and metering roller 36 are driven directly by hydraulic motors 44 and 46 respectively, while coating roller 32 is driven indirectly by the motor via gear wheels 79, 80, and 81. Those skilled in the art will recognize that the precise manner in which the rollers are driven may be changed to accommodate different arrangements, the particular arrangement shown in FIG. 2 therefore representing only an example of a presently preferred embodiment of the invention.

Frame 38 of spot coating assembly 30 is laterally translatable on horizontally disposed traverse rod 86 rigidly mounted in a support 89, which is attached to coating unit 10. Frame 38 is attached to bearing blocks 92 and 94, that slidably engage rod 86. Linear hydraulic actuator 96 is attached to bracket 97 of frame 38 at one end, and to support 89 at the other, for laterally translating coating assembly 30 into and out of engagement with plate cylinder 12 as illustrated in FIGS. 1 and 2 respectively.

While plate coating assembly 30 is supported on a cantilevered arm of support 89 in accordance with a presently preferred embodiment of this invention, other functionally equivalent arrangements might be useful on printing stages having different configurations from the ones shown.

Referring now to FIGS. 1 and 3, the blanket coating assembly 100 of the invention is shown. Like the spot coating assembly, blanket coating assembly 100 includes a pickup roller 104 extending into a tray 105 adapted to contain a supply of coating liquid, such as lacquer or the like. Pickup roller 104 rotates clockwise and transfers the coating liquid onto blanket coating roller 106 in an amount determined by metering roller 108. The pickup, metering and blanket rollers are driven by hydraulic motors 110, 112 and 114 respectively, either directly or via gear wheels in like manner to the plate coater already described. The motors are supplied with pressurized hydraulic fluid through lines 116 in the manner already described in connection with the plate coating assembly 30. Similarly, speed sensors, not shown, are operatively engaged with each of the rollers or the motors to provide feedback signals representing the rotational speed of the rollers.

Blanket coating assembly 100 is carried by bearing blocks 120 and 122 slidably mounted on traverse rod 124, which is rigidly attached to cantilever arm 130 of carriage 132. Linear hydraulic actuator 133 has one end 136 coupled to a bracket 138, which is attached to blanket coating assembly 100 by bolts 141, or in other convenient fashion. Operation of actuator 134 translates plate coating assembly 100 into and out of engagement with blanket cylinder 14. Carriage 132 is attached to lifting cable 134, which extends up track 140 to conventional lifting means (not shown) to permit blanket coating assembly 100 to be raised to the position shown in phantom in FIG. 1, for cleaning or other servicing. Conventional means, such as a linear hydraulic actuator attached to cable 134, are employed to pull carriage 132 to the raised position. It will be appreciated by reference to FIG. 3, that it is necessary to laterally translate assembly 100 to the left before raising the carriage, in order that blanket coating roller 106 will clear the periphery of plate cylinder 12, as the carriage is raised.

When the carriage is raised, space is created on platform 150 for an operator to service blanket coating assembly 100.

It will be understood that a second controller unit similar to controller 20 is provided for controlling the rotation of pickup roller 104, metering roller 108 and coating roller 106. This controller is not shown in the drawings, because the connections thereto would obscure the remaining elements of the invention and are in any event identical to those already shown and described in connection with the plate coater. As was the case in connection with spot coater 30, hydraulic motor 14 drives coating roller 106 through an intermediate gear 152 in conventional fashion.

While the invention has been described in connection with a presently preferred embodiment thereof, those skilled in the art will recognize that certain modifications and changes may be made therein without departing from the true spirit and scope of the invention, which accordingly is intended to be defined solely by the appended claims.

What is claimed is:

1. Coating apparatus for applying continuous or spot coatings to a plate cylinder and a blanket cylinder of a printing press in which the plate cylinder is disposed generally above the blanket cylinder and arranged so that either of a plate coater and a blanket coater can be serviced while the other coater is operating;
   - a retractable blanket coater disposed on one side of the plate and blanket cylinders for transferring a layer of coating material to the blanket cylinder;
   - a retractable plate coater disposed on a side of the plate and blanket cylinders opposite the blanket coating roller for applying coating material to said plate cylinder;
   - blanket coater retracting means for moving said blanket coater between an operating position in contact with said blanket cylinder and a service position out of contact with the blanket cylinder;
   - plate coater retracting means for moving said plate coater between an operating position in contact with said plate cylinder and a service position out of contact with the plate cylinder; and
   - lifting means for lifting the blanket coater away from the blanket cylinder so that when one of the plate and blanket coaters is operating and the other is out of contact, the out of contact coater may be serviced without interfering with the operation of the operating one of the plate and blanket coaters.

2. The coating apparatus of claim 1 in which the plate coater comprises a plate coating roller and in which the blanket coater comprises a blanket coating roller and a plate coater motor for rotating said plate coating roller; a blanket coater motor for rotating the blanket coating roller; and also comprising
   - speed sensor means for providing a press speed signal; and
   - control means responsive to the press speed signal for controlling the speed of the plate coater motor and the blanket coater motor.

3. The coating apparatus of claim 2 wherein sid speed sensor means comprises tachometer means coupled to one of the plate cylinder and the blanket cylinder.

4. The coating apparatus of claim 2 further comprising a pickup roller for transferring a coating liquid to the plate coating roller and a metering roller for controlling the amount of coating liquid transferred to the plate coating roller.

5. The coating apparatus of claim 4 further comprising motor means for rotating the pickup roller and the metering roller.

6. The coating apparatus of claim 5 wherein said control means is connected to sid motor means for varying the speed of the pickup roller and the metering roller in response to the press speed signal.

7. The coating apparatus of claim 2 further comprising a pickup roller for transferring a coating liquid to the blanket coating roller and a metering roller for controlling the amount of coating liquid transferred to the blanket coating roller.

8. The coating apparatus of claim 7 further comprising motor means for rotating the pickup roller and the metering roller.

9. The coating apparatus of claim 7 wherein said control means is connected to said motor means for varying the speed of the pickup roller and the metering roller in response to the press speed signal.

10. Coating apparatus for a printing press including a plate cylinder and a blanket cylinder, comprising:

a coating assembly including a coating roller engaging one of the plate cylinder and the blanket cylinder, a pickup roller engaging the coating roller, and a metering roller; drive motors coupled to each of the coating roller, the pick up roller and the metering roller; and

speed sensor means coupled to a printing press and responsive to the speed of the press and coupled to

the drive motors for independently controlling the rotational speeds of at least two of the coating roller, the pickup roller and the metering roller.

11. The coating apparatus of claim 10 in which the speed sensor means comprises a tachometer coupled to the press.

12. The coating apparatus of claim 11 in which the tachometer is coupled to the plate cylinder of the press.

13. The coating apparatus of claim 10 comprising individual speed controllers for each of the drive motors, so that the relative speed at the nip between any two adjacent rollers can be adjusted.

14. The coating apparatus of claim 13 further comprising means for maintaining the relative speeds of the pickup, metering and coating rollers as the press speed varies.

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US005127329A

United States Patent [19]

DeMoore et al.

[11] Patent Number: 5,127,329

[45] Date of Patent: Jul. 7, 1992

[54] **VACUUM TRANSFER APPARATUS FOR ROTARY SHEET-FED PRINTING PRESSES**

[75] Inventors: Howard W. DeMoore, Dallas; Howard C. Secor, Coppell, both of Tex.

[73] Assignee: Howard W. DeMoore, Dallas, Tex.

[21] Appl. No.: 630,308

[22] Filed: Dec. 18, 1990

[51] Int. Cl.[5] B41F 13/02

[52] U.S. Cl. 101/420; 101/231; 101/232; 101/217; 101/492; 101/480; 271/276; 271/277; 271/194

[58] Field of Search 101/183, 231, 232, 217, 101/216, 215, 492, 480, 408, 420; 271/194, 276, 277, 82, 183

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Primary Examiner—Edgar S. Burr
Assistant Examiner—Eric P. Raciti
Attorney, Agent, or Firm—Dennis T. Griggs

[57] **ABSTRACT**

A vacuum transfer apparatus for use in a sheet fed rotary printing press for supporting the unprinted side of a freshly printed sheet as it is moved from the press impression cylinder along a transfer path to a further processing station of the press, the apparatus including a vacuum chamber supporting a plurality of rotatable elongated rollers arrayed in spaced side-by-side parallel relationship laterally across the transfer path, and a vacuum pump connected to the chamber for producing a pressure differential across the freshly printed sheet to draw the unprinted side of the sheet into engagement with the support rollers by drawing air into the vacuum chamber through the spaces between the rollers as the sheet is pulled along the transfer path so that the printed side of the sheet can not be marked or marred.

29 Claims, 6 Drawing Sheets

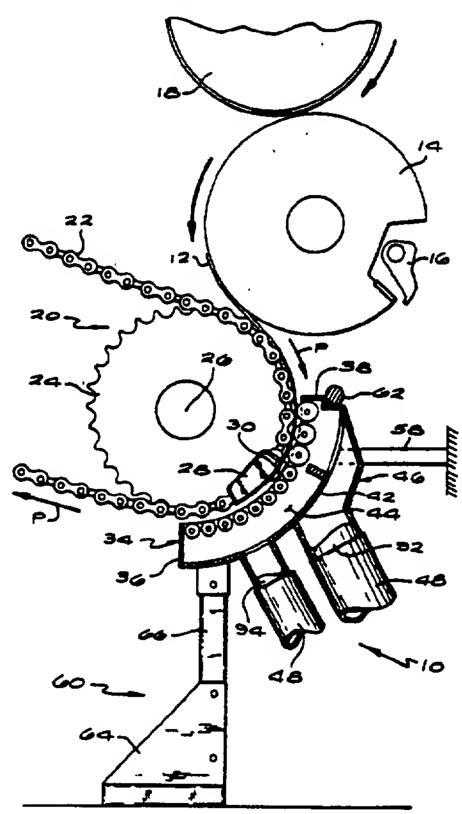

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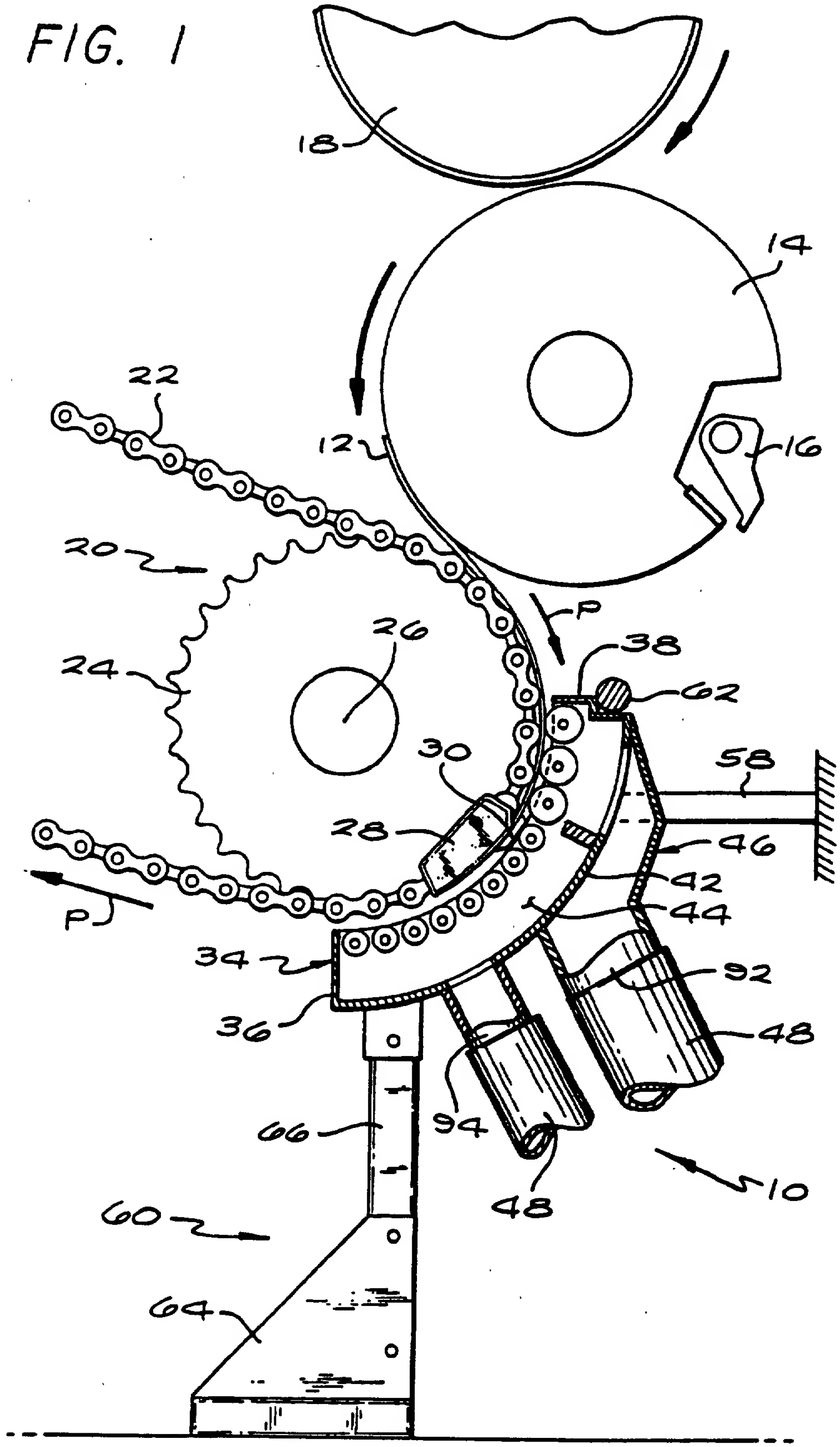
FIG. 1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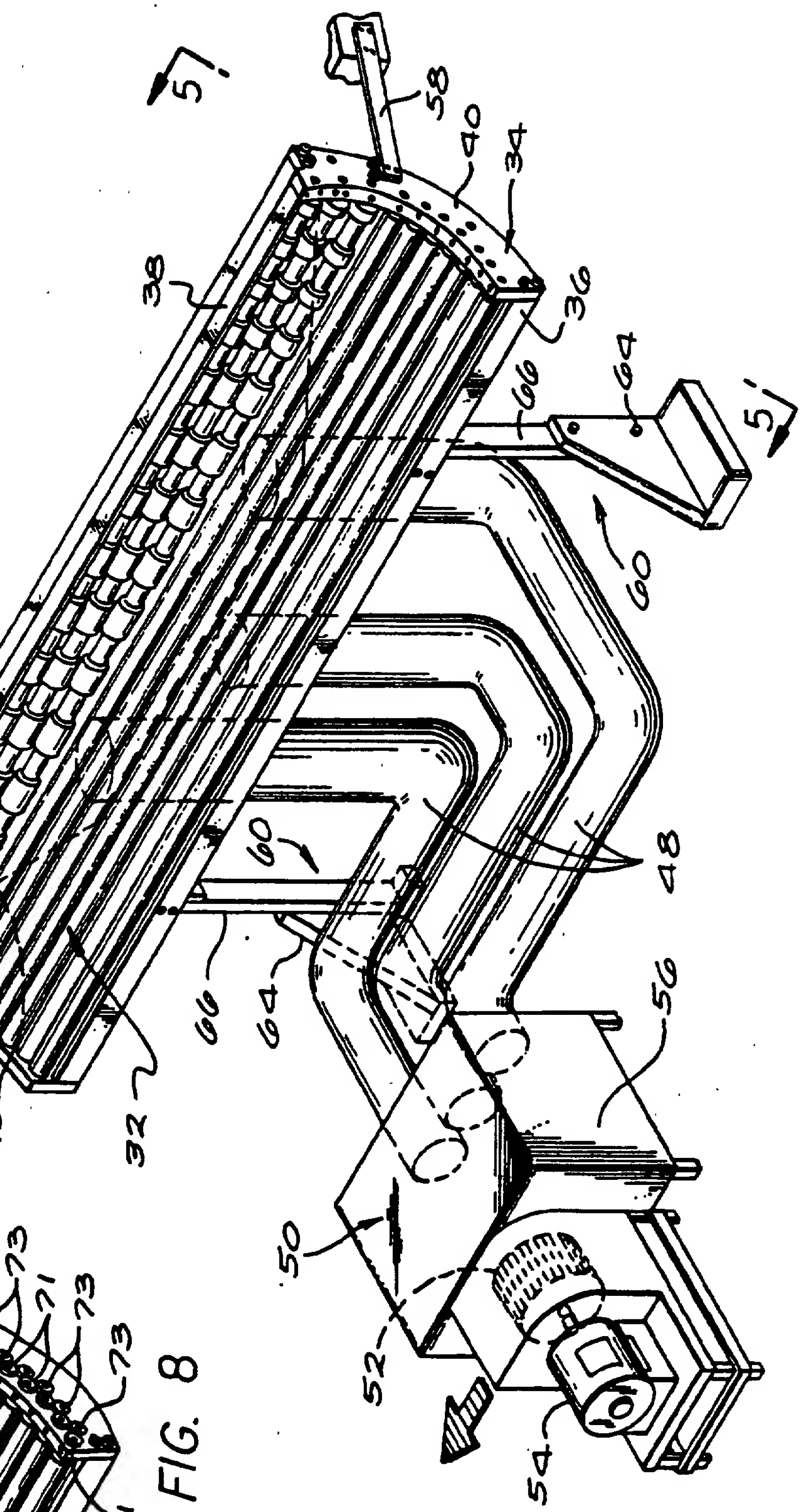
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FIG. 2

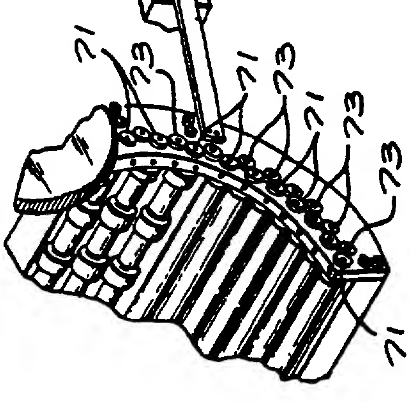
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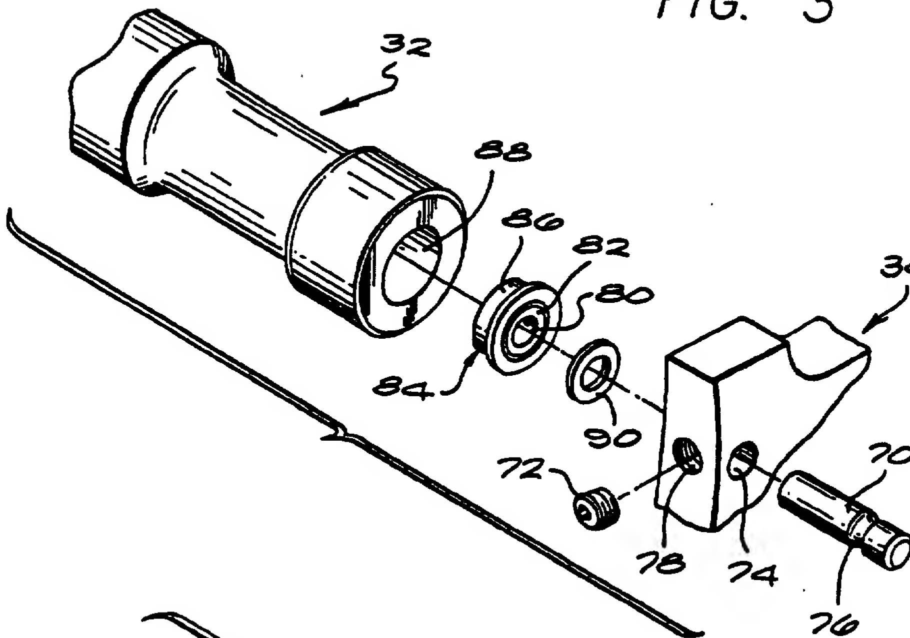
FIG. 8

FIG. 3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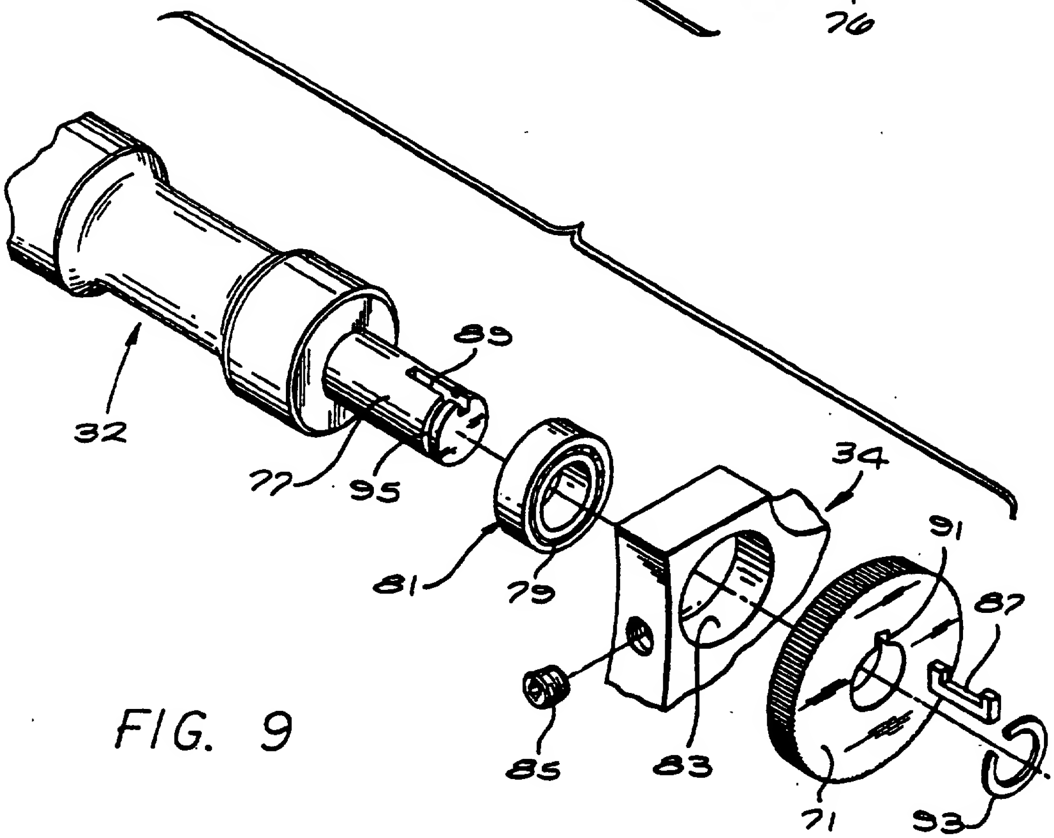
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FIG. 9

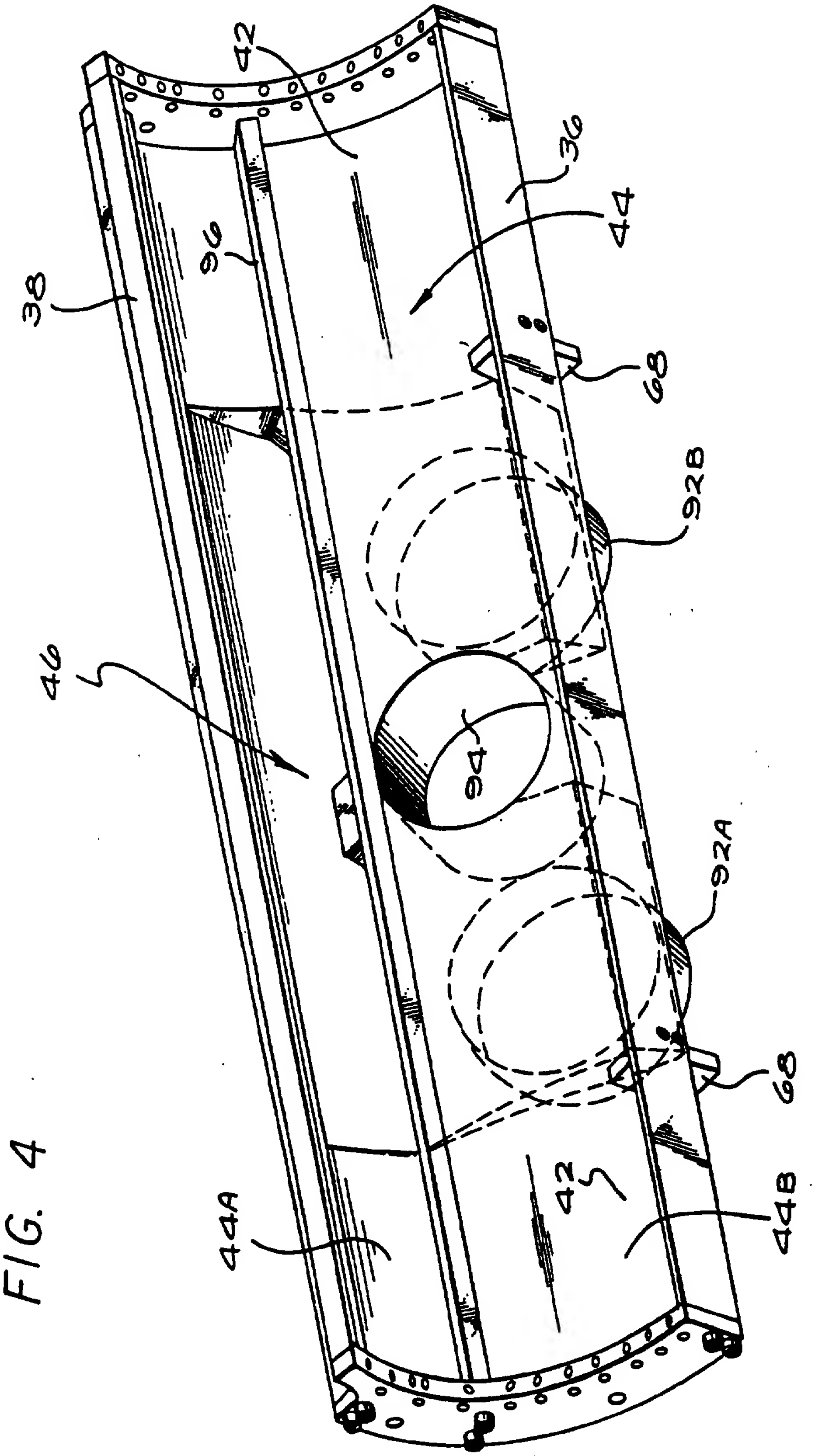
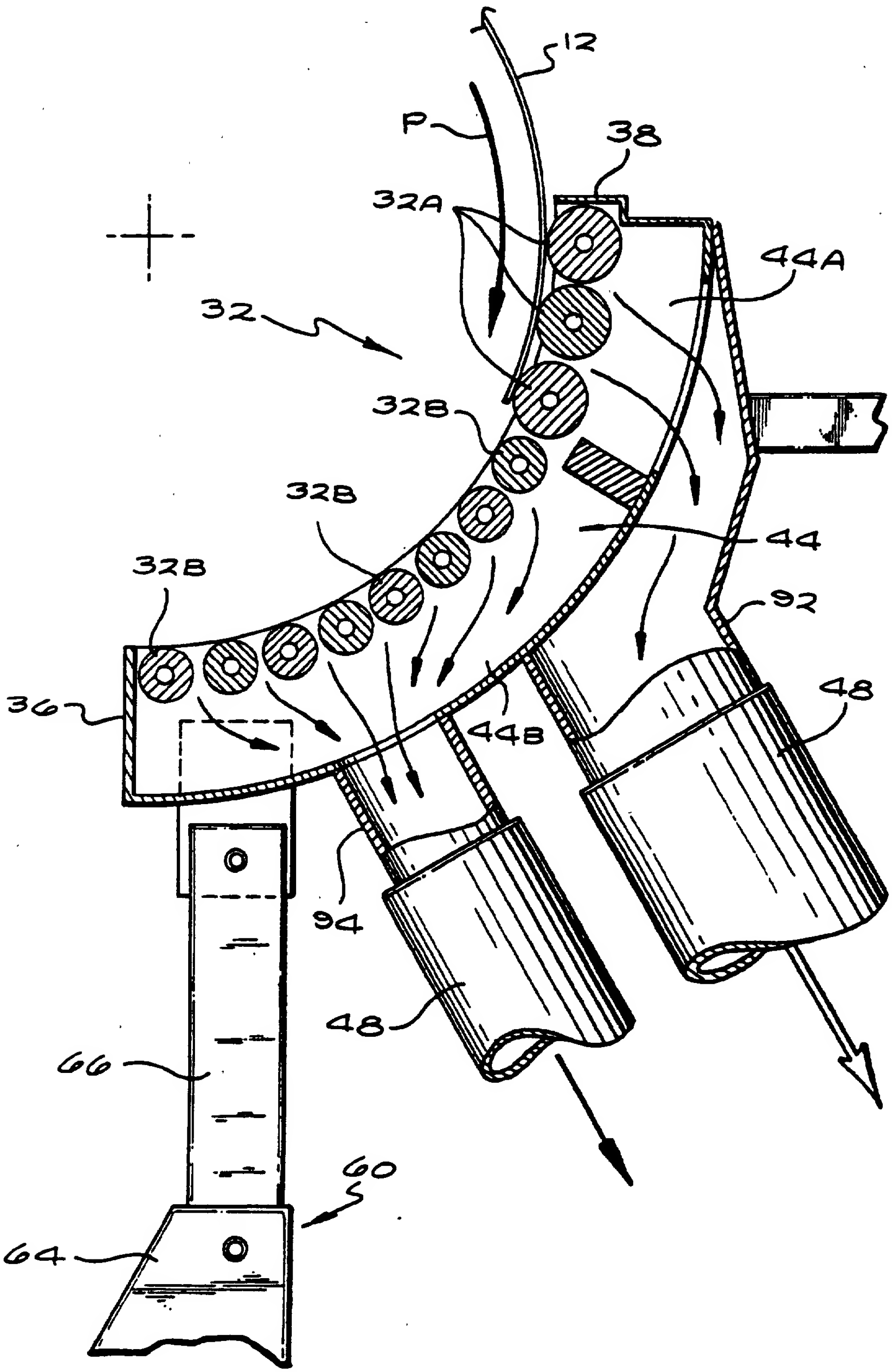


FIG. 4

FIG. 5



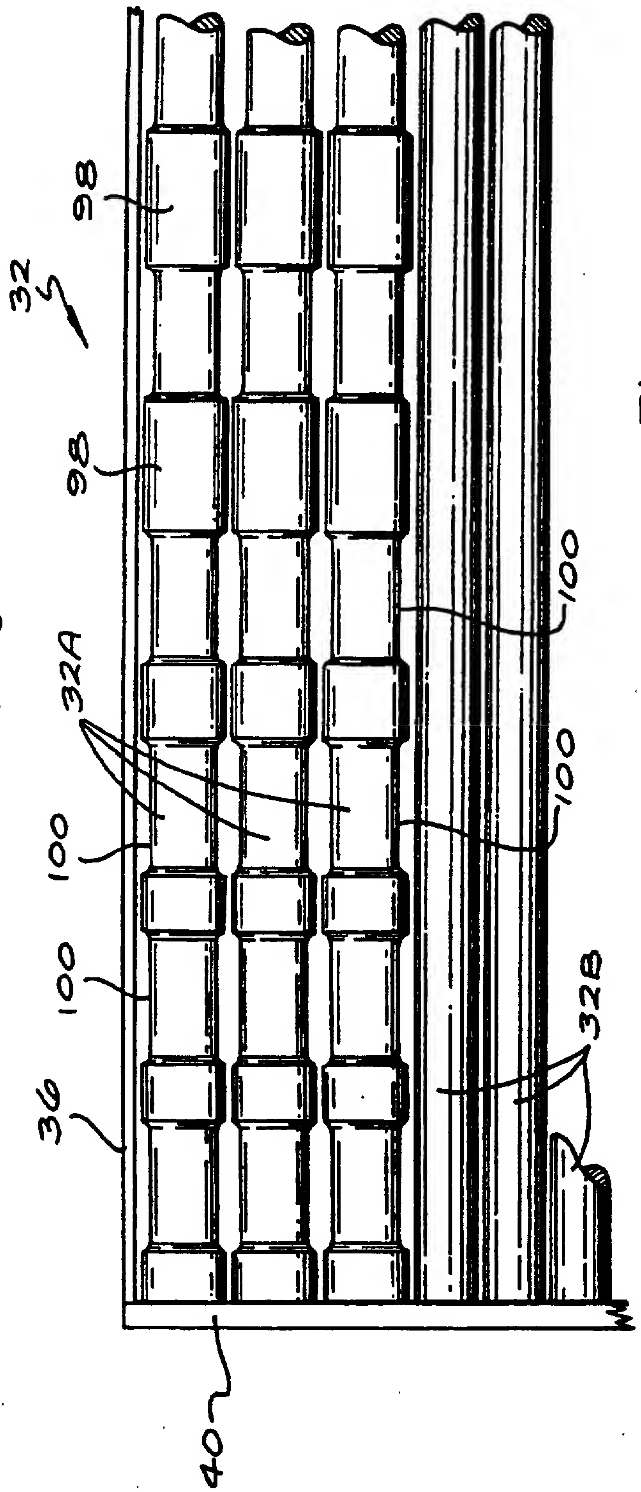


FIG. 6

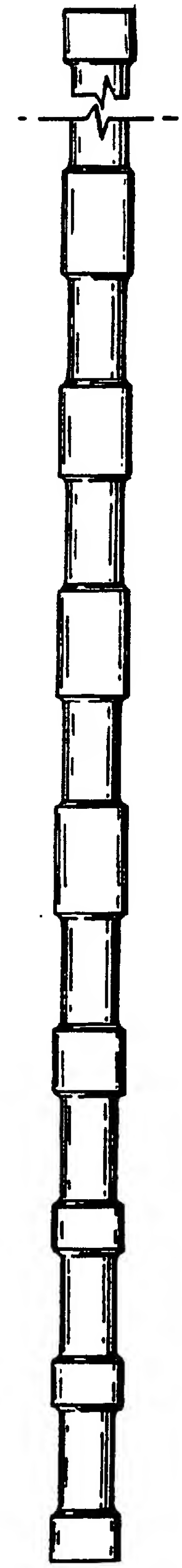


FIG. 7

VACUUM TRANSFER APPARATUS FOR ROTARY SHEET-FED PRINTING PRESSES

BACKGROUND OF THE INVENTION

This invention relates to rotary sheet-fed offset printing presses, and more particularly to a new and improved anti-marking vacuum transfer apparatus for supporting freshly printed sheets as they are moved between processing stations within the press.

During the movement of sheets being printed through a rotary sheet-fed offset printing press, it is conventional to employ a transfer or delivery system which engages and supports the wet ink side of the sheet as the sheet is moved between processing stations. Typically, a "transfer" system denotes an apparatus disposed between the several printing stations in the press and which functions to receive a freshly printed sheet from one impression cylinder and move the sheet to the next printing station for additional printing by a further impression cylinder. A "delivery" system typically denotes an apparatus which receives the freshly printed sheet from the last impression cylinder of the press, and delivers the sheet to the press delivery station, typically a sheet stacker. As used hereinafter, the term "transfer" is intended to include both apparatus used to transfer a sheet between printing stations of the press and an apparatus used for delivering the sheets to the press delivery stacking station.

One problem inherent in all transfer systems which engage and support the printed side of the sheet is that of marking and smearing the freshly applied ink. In the past, efforts to reduce sheet marking and marring have included employing apparatus such as those referred to in the trade as skeleton wheels and cylinders, and which have sheet engaging surfaces intended to minimize the area of sheet contact while still providing sheet support. Exemplary of such prior art devices are those discussed in the Background of the Invention of U.S. Pat. No. 3,791,644 issued Feb. 12, 1974 to Howard W. DeMoore entitled "SHEET HANDLING APPARATUS".

Another approach employs a transfer system having a cylinder with a specially prepared friction reducing support surface covered by a fabric cloth, known in the trade as a "net", and which is more fully described in U.S. Pat. No. 4,402,267 issued Sep. 6, 1983 to Howard W. DeMoore, entitled "METHOD AND APPARATUS FOR HANDLING PRINTED SHEET MATERIALS". That system, which is marketed under license by Printing Research, Inc. of Dallas, Tex. under its registered trademark "SUPER BLUE", actually maximizes the area of contact between the wet ink side of the sheet and the net covered surface of the transfer cylinder.

While the "SUPER BLUE" system has received wide spread industry acceptance and has enjoyed substantial commercial success, after prolonged use it is often necessary that the fabric net be replaced due to a build-up of ink on the net surface, or as a result of the net becoming excessively worn and/or torn. While the "SUPER BLUE" system allows the fabric net to be replaced relatively quickly, replacement of the net still requires that the press be shut down, thereby resulting in periodic press down time.

In many printing applications, only one side of the sheet receives ink from the blanket cylinders during each pass through the printing press. Applicants have found that in those situations where only one side of the sheet is to be printed, use of a transfer system which engages and supports the printed side of the sheet may be unnecessary and a transfer system can be used which engages and supports the nonprinted side of the sheet. For example, in non-perfector type printing presses, only one side of the sheet is printed during each pass through the press. In such presses, conventional transfer systems which support and engage the printed side of the sheet can be eliminated, and a transfer system which engages and supports only the nonprinted side of the sheet can be used.

In U.S. Pat. No. 2,933,039 issued Apr. 19, 1960 to Clayborn et al., entitled "SHEET TRANSFERRING MECHANISM", there is disclosed a transfer system for preventing sheet marking and which is intended to be a substitute for conventional transfer apparatus which engage and support the printed side of the sheet. That patent discloses a stationary curved sheet guide having a solid surface mounted adjacent to the path of the sheet transfer grippers and which supports the nonprinted side of a freshly printed sheet as it is pulled by the grippers from the impression cylinder. As discussed in that patent, provision is made for creating a negative pressure between the sheet and the solid surface of the sheet guide so that the sheet is drawn into engagement with the sheet guide as it is pulled by the grippers from the impression cylinder. Since only the nonprinted side of the sheet is engaged and supported by the sheet guide, marking and marring of the freshly printed surface cannot occur.

In U.S. Pat. No. 4,572,071 issued Feb. 25, 1986 to Cappel et al., entitled "DEVICE FOR GUIDING SHEET PRINTED ON ONE OR BOTH SIDES", there is disclosed an improvement over the foregoing Clayborn et al. patent, and which suggests employing a stationary curved sheet guide having an apertured solid support surface through which air can be drawn to create a negative pressure on the sheet, thereby to draw the nonprinted side of the sheet against the sheet guide. In this respect, this patent suggests that the sheet guide be formed as the surface of a plenum chamber coupled to a plurality of fans which can be selectively operated to either provide a negative pressure within the plenum chamber, or a positive pressure within the chamber such that the sheet can, respectively, be either drawn against the surface of the sheet guide in the case of single sided printing, or "floated" above the surface of the sheet guide in the case of two sided printing.

Applicants have found that with stationary sheet guide apparatus of the type disclosed in the Clayborn et al. and Cappel et al. patents, since the sheet is drawn onto and pulled against the substantially solid support surface of the sheet guide, the nonprinted side of the sheet may tend to be scratched and marred as it slides over the solid support surface. Further, use of stationary sheet guide apparatus of the types suggested by the Clayborn et al. and Cappel et al. patents may result in the sheet being pulled partially or fully from the transfer grippers due to the high frictional force created between the sheet and the supporting surface of the sheet guide, thereby resulting in sheet misalignment and destroyed registration for subsequent printing by the next printing unit.

As will become more apparent hereinafter, the present invention provides a new and improved transfer apparatus for supporting the nonprinted side of a sheet

which solves the foregoing problems in a novel and unobvious manner.

SUMMARY OF THE INVENTION

The present invention provides a new and improved vacuum transfer apparatus for conveying freshly printed sheets between processing stations within a printing press by supporting the sheet on the nonprinted side in such a manner as to insure that the sheet is not scratched or marred, and precise sheet registration is maintained. The apparatus of the invention is relatively inexpensive to manufacture, highly reliable in use, and can be readily installed in existing presses as a replacement for traditional transfer apparatus, or as an alternative transfer system usable when only one sided sheet printing is being made.

In accordance with the present invention, the vacuum transfer apparatus includes an arcuate array of support rollers adapted to engage and support the nonprinted side of a freshly printed sheet as it is moved from the impression cylinder along the transfer path. The support rollers are mounted to a frame for rotation in side-by-side spaced relationship, and are arrayed to extend laterally across the transfer path. The frame which supports the rollers has substantially closed sides and forms a vacuum chamber with the rollers defining a face of the chamber adjacent the transfer path. The vacuum chamber formed by the frame and support rollers is coupled to a vacuum producing source such as a fan or pump for creating a negative pressure within the chamber to pull air into the chamber between the spaced rollers. As air is pulled through the space between the rollers into the vacuum chamber, the nonprinted side of a freshly printed sheet is drawn into engagement with the support rollers which rotate with the sheet to support and covey the sheet along the transfer path. In this manner, friction between the sheet and the support rollers is substantially eliminated, thereby preventing the possibility of scratching or marring the nonprinted side of the sheet, and insuring that the sheet is not pulled from the transfer grippers so as to destroy sheet registration.

Additionally, the support roller array is designed and dimensioned to provide a larger air flow volume adjacent the leading edge of the transfer apparatus to facilitate initial sheet redirection or "sheet break" as it leaves the impression cylinder, and the individual rollers adjacent the leading edge of the vacuum transfer device are contoured to permit the roller array to be mounted as closely as possible to the transfer path, thereby to eliminate minimize the possibility of sheet marking and misregistration, and to reduce the vacuum requirements of the system. In one embodiment, the rollers are mounted to the frame of the vacuum chamber for free rotation about their longitudinal axes, and in another embodiment, the rollers are positively driven about their axes to rotate at the same speed as that of the speed of travel of the sheet along the transfer path. In either case, the rollers support the sheet such that relative motion between the sheet and support surfaces of the rollers is minimized to prevent scratching or marring of the unprinted side of the sheets, and to prevent the sheet from being pulled out of the transfer grippers.

When installed in existing printing presses, the vacuum transfer apparatus of the invention can be used to supplement existing transfer systems, or to replace such systems. When used as a supplement to existing transfer systems, such as when installed in a perfector type press, the apparatus of the present invention can be selectively used to transfer freshly printed sheets which are to be printed on only one side during a single pass through the press, and can be inactivated when used during two-sided printed operations.

These and other features and advantages of the present invention will become more apparent from the following detailed description, taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary side elevational view schematically showing an anti-marking vacuum transfer apparatus constructed in accordance with the present invention and mounted in a transfer station of a Heidelberg 102 Speedmaster press;

FIG. 2 is an enlarged, isolated perspective view of the vacuum transfer apparatus of FIG. 1 without the press components, and illustrating the apparatus coupled to a pump;

FIG. 3 is an enlarged fragmentary exploded perspective view of the mounting for a support roller and bearing assembly of the roller array used in one preferred embodiment of the vacuum transfer apparatus of FIG. 1;

FIG. 4 is an enlarged perspective view of the frame forming a vacuum chamber of the vacuum transfer apparatus of FIG. 1, and shown with the roller array removed for clarity of illustration;

FIG. 5 is an enlarged sectional view taken substantially along the line 5—5 of FIG. 2;

FIG. 6 is a fragmentary plan view of the roller array of the vacuum transfer apparatus shown in FIG. 2 with roller spacing dimensions of the exemplary embodiment added;

FIG. 7 is an isolated plan view of a large diameter roller of the roller array used in the vacuum transfer apparatus of FIG. 1, and showing the roller dimensions of the exemplary embodiment;

FIG. 8 is a fragmentary perspective view illustrating the support roller array used in an alternative embodiment for positively driving the rollers; and

FIG. 9 is an enlarged fragmentary perspective view showing the mounting for the support rollers of the embodiment of FIG. 8.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENT

As shown in the exemplary drawings, the present invention is embodied in a new and improved anti-marking vacuum transfer apparatus 10 primarily intended for use in a sheet fed, offset rotary printing press of conventional design, to engage and support the nonprinted side of a freshly printed sheet 12 as it is moved from an impression cylinder 14 of the press to a further processing station within the press. In this instance, sheets 12 to be printed are pulled by sheet grippers 16 attached to the impression cylinder 14 through the nip between the impression cylinder and a blanket cylinder 18 where ink is applied to one side of the sheet. After ink has been applied to the printed face of the sheet 12, a transfer conveyor 20 grips the leading edge of the sheet at the impression cylinder 14, and pulls the sheet from the impression cylinder, around the transfer apparatus 10, and then to a further processing station within the press, typically to another impression cylinder for

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further printing or to the press delivery stacker (not shown).

Herein, the transfer conveyor 20, which is also of conventional design, comprises a pair of endless chains 22 (only one of which is shown) trained about sprocket wheels 24 laterally disposed on each side of the press and centrally supported by a drive shaft 26. Extending laterally across the endless chains 22 at spaced intervals are sheet gripper assemblies 28 carrying a plurality of conventional sheet grippers 30 which operate to grip the leading edge of the sheet 12 at the impression cylinder 14, and move the sheet along the transfer path defined by the path of movement of the chain conveyors, the transfer path being herein generally designated by the arrows P. It should be noted that in conventional printing presses, the drive shaft 26 supporting the sprocket wheels 24 typically also functions to support many of the conventional transfer systems such as skeleton wheels, transfer cylinders, and the like. As will become more apparent hereinafter, the vacuum transfer apparatus 10 of the present invention can be positioned within the press with or without removing the conventional transfer apparatus then existing in the press.

In accordance with the present invention, the vacuum transfer apparatus 10 includes an arcuate array of support rollers 32 disposed along the transfer path P to engage and support the nonprinted side of a freshly printed sheet 12 in such a manner to insure that scratching and marring of the nonprinted side of the sheet does not occur, and that sheet registration is maintained. The vacuum transfer apparatus 10 of the invention is relatively inexpensive to manufacture, highly reliable in use, and can be readily installed in most existing presses with out requiring modification of existing transfer systems.

Toward the foregoing ends, the support rollers 32 are mounted for rotation to a frame, generally designated 34, and arrayed to extend side-by-side in spaced, parallel relation laterally across substantially the full width of the transfer path P. In this instance, the frame 34 is formed to create an internal vacuum chamber 44 defined by upper and lower end walls, 36 and 38, respectively, a pair of laterally spaced side walls 40, and a rear wall 42. Each of the side walls 40 has an arcuate shape corresponding to the arc of curvature of the transfer path P, and the support rollers 32 are mounted to the side walls opposite the rear wall 42 so that the rollers overlie the vacuum chamber 44 and form an arcuate path corresponding to that of the transfer path. Interconnected with the vacuum chamber 44 is a manifold 46 coupled by suitable air ducts 48 to a vacuum producing source 50, herein comprising a squirrel cage-type suction fan 52 driven by an induction motor 54. As shown in FIG. 2, a suction air plenum 56 is interposed between the fan 52 and the air ducts 48, such that when the fan is operated, air is pulled from the plenum by the fan, thereby creating a negative pressure within the plenum to pull air from the vacuum chamber 44 through the air ducts.

As a result of the creation of a negative or vacuum pressure within the vacuum chamber 44, air is drawn into the chamber through the spaces between the support rollers 32. This air flow creates a suction force along the transfer path P which will cause a sheet 12 being pulled from the impression cylinder 14 by the transfer conveyor 20 to be drawn into engagement with the support surfaces of the rollers 32. Preferably, the support rollers 32 are mounted to the side walls 40 such that the supporting surfaces of the rollers lie along the transfer path P or very sightly spaced radially outwardly therefrom (that is, toward the vacuum transfer apparatus 10) so that as a sheet 12 is supported and conveyed along the rollers, the grippers 30 can pass over the rollers and the sheet will not engage any other apparatus in the press, including any conventional transfer system components that may be present. Thus, the printed side of the sheet 12 will be maintained out of contact with any other apparatus, and can not possibly be marked, smeared or otherwise marred during the transfer.

In mounting the vacuum transfer apparatus 10 to the press, it is important to attempt to position the upper end of the frame 34 as close to the impression cylinder 14 as practically possible to insure a smooth transfer of sheets 12 from the impression cylinder to the support rollers 32. While different types of mountings may be required for different types of printing presses, herein the vacuum transfer apparatus 10 of the exemplary embodiment is illustrated mounted in a Heidelberg 102 Speedmaster press. As shown, the frame 34 is mounted to the press adjacent its upper end by a pair of mounting brackets 58 coupled to the press frame, and at its lower end by a pair of laterally spaced stanchions 60 supported by the floor on which the press stands. In this instance, the particular press shown has a rotating shaft 62 extending laterally across the press parallel with the impression cylinder 14, and which limits the location of the vacuum apparatus 10 within the press. The stanchions 60 herein include foundation blocks 64 coupled to the frame 34 by vertical legs 66 bolted to mounting blocks 68 secured to the bottom wall 42 of the frame.

In accordance with an important aspect of the present invention, the support rollers 32 are each mounted to the frame 34 for rotation so as to minimize any tendency of the sheets 12 to slide or skid over the roller support surfaces which could result in scratching or marring of the nonprinted side of the sheet. To achieve this end, in one presently preferred embodiment, the rollers 32 are mounted for free rotation (see FIGS. 2 and 3), and in another embodiment, the rollers are positively driven about their axes of rotation (see FIGS. 8 and 9). In this respect, due to the high volume of particulate material which is present in a press environment during use, such as paper dust, anti-offset powder, and other harmful materials, it is desirable that the rollers 32 be readily replaceable in the event of a roller malfunction.

Toward this end, in the presently preferred embodiment best seen in FIG. 3, each roller 32, which preferably is made of tubular or solid aluminum stock, is mounted for free rotation to the side walls 40 of the frame 34 by stub axles 70 removably secured to the side walls by set screws 72. Each stub axle 70 has an outer end portion which herein projects through a bore 74 formed in the side wall 40 of the frame 34, and is provided with an annular recess 76 into which the set screw 72 projects, a threaded opening 78 being provided in the side wall to intercept the bore. The inner end portion of the stub axle 70 extends into a central opening 80 formed through the inner race 82 of a sealed bearing 84. The outer race 86 of the bearing 84 is friction fit into an axial bore 88 formed in the end of the roller 32, and the mounting is completed by positioning a donut-shaped washer 90 between the bearing 84 and the side wall 40. With this arrangement, the roller 32 is free to rotate on the bearing 84 about the stub axle 70, and can be quickly and easily released for removal from the frame 34 sim-

ply by removing the set screws 72 and withdrawing the stub axles from the bearings through the bores 74.

In an alternative embodiment best seen in FIGS. 8 and 9, the rollers 32 may be mounted to the frame 34 to be positively driven at the same surface speed as the speed of the sheet 12 moving along the transfer path P so that no relative motion between the sheet and the support surface of the rollers can occur. In this instance, the rollers 32 have pinion gears 71 drivingly coupled to each other through idler gears 73 mounted to the side walls 40 of the frame 34, the initial pinion gear being driven by a suitable drive gear 75 coupled to the press, for example, coupled to the drive shaft of the impression cylinder 14. While any suitable drive source from the press can be used, what is important is to select suitable drive gear 75, idler gear 73, and pinion gear 71 ratios that will insure that the support rollers 32 each are driven at the same speed as the speed of travel of the sheet along the transfer path P.

To permit the driven rollers 32 to be releasably mounted to the frame 34, herein each roller includes an axle 77 fixed to the end of the roller and which extends through the inner race 79 of a sealed bearing 81 releasably retained in a bore 83 formed in the side wall 40, the bearing herein being retained in the bore by a removable set screw 85. Each pinion gear 71 is retained on the end of the axle 77 by a key 87 mounted in key-ways 89 and 91 formed, respectively, in the axle and pinion gear, and a C-shaped retainer 93 removably mounted in an annular groove 95 formed adjacent the end of the axle. Preferably, only one end of the roller array will include pinion gears 71, it being understood that the ends of each of the rollers 32 opposite the driver ends can be similarly mounted to the side walls 40 but will not include pinion gears.

To insure that the transfer of sheets 12 from the impression cylinder 14 to the vacuum transfer apparatus 10 is accomplished smoothly and in such a manner as to eliminate the possibility of the sheet coming into contact with other parts of the press, it is important that a sheet be quickly and smoothly brought into contact with the support rollers 32 as it is initially pulled from the impression cylinder by the transfer grippers 30. To achieve this result, the vacuum transfer apparatus 10 must rapidly change the direction of travel of the sheets 12 as each sheet leaves the surface of the impression cylinder 14. Moreover, this reversal of direction, referred in the trade as "sheet break", must be accomplished smoothly and uniformly to insure that the sheet is not pulled fully or partially out of the grippers of the transfer conveyor since movement of the sheet in the grippers will result in sheet misregistration.

To achieve these ends, the vacuum transfer apparatus 10 of the present invention includes means for providing a greater amount of air flow, and hence a greater suction force, along the transfer path P for the portion of the transfer apparatus adjacent the impression cylinder 14 than that for the portion of the apparatus further along the transfer path P. By providing a larger air flow into the vacuum chamber 44 in the portion of the vacuum transfer apparatus 10 adjacent the impression cylinder 14, the leading edge of a sheet 12 being transferred can be caused to be pulled rapidly against the support rollers 32, thereby to effect a rapid sheet break. As the sheet 12 progresses further along the transfer path P, less air flow is required to maintain the sheet in engagement with the support rollers 32, and the sheet will remain engaged with the rollers yet experience a lower resistance to forward movement due to the lower level of suction force exerted by the vacuum transfer apparatus 10.

To achieve the desired air flow differential, the presently preferred embodiments of the invention employ the combined effects achieved by forming a partition in the vacuum chamber 44, and increasing the effective area between the support rollers 32 disposed adjacent the impression cylinder 14. As best can be seen in FIG. 4, a divider wall 96 is secured to the rear wall 42 to extend laterally across the inside of the vacuum chamber 44, and separates the chamber into upper and lower portions, designated 44A and 44B, respectively. As shown, the upper chamber portion 44A comprises approximately one third the total vacuum chamber area, while the lower portion 44B constitutes the remaining approximately two thirds. The manifold 46 herein is formed to provide three air openings into the vacuum chamber 44, two of which, designated by reference numerals 92A and 92B, communicate with the chamber upper portion 44A, and the third, designated 94, communicating with the chamber lower portion 44B. In this manner, a substantially greater air flow through the vacuum chamber upper portion 44A can be accommodated than that through the chamber lower portion 44B, thereby substantially increasing the suction force exerted on a sheet 12 as it is initially pulled onto the vacuum transfer apparatus 10.

To provide a greater air flow area along the transfer path P between support rollers 32 adjacent the impression cylinder 14, it is possible merely to space the support rollers in this area further apart along the side wall 40 of the frame 34. However, it has been found that superior results can be achieved by forming the initial support rollers 32 overlying the vacuum chamber upper portion 44A to have an effective diameter larger than the remaining support rollers, and to form the roller support surfaces to have a contoured shape to create areas of roller separation which are enlarged. Formation of the initial support rollers 32 in this manner insures that the sheets 12 being transferred will have adequate support and not be drawn or deflected into the space between the rollers, and permits the initial rollers to be mounted closer to the transfer path P than would otherwise be permitted, this further aiding in a smooth and uniform transfer of sheets from the impression cylinder 14 to the vacuum transfer apparatus 10.

With primary reference to FIGS. 5 and 6, the array of support rollers 32 herein includes three initial rollers, designated 32A, of relatively larger diameter disposed to overlie the vacuum chamber upper portion 44A, and eight rollers of relatively smaller diameter, designated 32B, overlying the remainder of the vacuum chamber 44. In the exemplary embodiment, it has been found that with rollers 32 having a length of 40 inches, satisfactory results can be achieved by using a 1/16 inch spacing between each support roller, and large diameter rollers 32A having a maximum diameter of one inch with small diameter rollers 32B having a ¾ inch diameter. Preferably, the top wall 38 and the bottom wall 36 of the frame 34 are also formed to provide a 1/16 inch gap with the adjacent roller 32 so that the total area of the vacuum transfer apparatus 10 defined along the transfer path P is approximately 41 inches wide by 9¾ inches long, or a total of approximately 399¾ square inches. Since the vacuum chamber upper portion 44A is approximately one third the total area of the vacuum chamber 44 along the transfer path P, the area of the upper portion is

approximately 133⅓ square inches, and that of the vacuum chamber lower portion 44B is approximately 266⅔ square inches.

To provide an increased air flow area between the large diameter rollers 32A, the sheet support surface, designated 98, is contoured by forming areas of reduced diameter along the length of the roller, preferably by spaced recesses 100 formed between areas of full diameter. In this instance, the recesses 100 are formed in each large diameter roller 32A so that the roller diameter is ¾ inch at the recess, thereby providing an effective air inlet increase between adjacent recesses of the large diameter rollers of ¼ inch.

Provision of recesses 100 also permits the large diameter rollers 32A to be located closer to the transfer path P since the recesses permit the grippers 30 of the transfer conveyor 20 to pass below the support surface 98 of the rollers. Typically, the grippers 30 of a transfer conveyor 20 project approximately ¼ inch beyond the gripper chain 22 in the direction radially outwardly with respect to the axis of the drive shaft 26 of the sprocket wheels 24. By locating the recesses 100 along the large diameter rollers 32A to coincide with the locations of the grippers 30, the grippers can pass freely through the recesses. Accordingly, the support surface portions 98 of the large diameter rollers 32A can be positioned to be substantially tangent to the true transfer path P, thereby providing a more smooth and uniform transition for the sheet 12 as it initially engages the vacuum transfer apparatus 10.

In the exemplary embodiments, the recesses 100 are each approximately 1-9/16 inch wide, but are not uniformly spaced along the large diameter rollers 32A. Rather, the location of the recesses 100 has been selected to coincide with the location of the grippers 30 found on the transfer conveyor 20 of the Heidelberg 102 Speedmaster press. In that particular type of press, the grippers 30 are spaced more closely together along the gripper bars 28 from the mid point laterally outwardly toward the ends at the chains 22 so that the recesses 100 must be similarly spaced to permit the grippers 30 to travel past the large diameter rollers 32A. With the recesses 100 dimensioned and located as shown in FIG. 6, the total effective air inlet area along the transfer path P defined by the larger diameter rollers 32A overlying the vacuum chamber upper portion 44A is approximately 27.8 square inches, and that defined by the smaller diameter rollers 32B overlying the vacuum chamber lower portion 44B is approximately 20.5 square inches. Thus, considering that the vacuum chamber upper portion 44A is one third the area of the overall vacuum chamber 44 and that there are two manifold openings 92A and 92B to the upper portion, the volume of air flow into the upper chamber is substantially greater, herein approximately twice that of the volume air flow into the vacuum chamber lower portion 44B which has only one manifold opening 94. With this relationship, it has been found that the sheet 12 will rapidly transfer smoothly and uniformly to the vacuum transfer apparatus 10, and will not be pulled from the grippers so as to destroy registration.

While the foregoing specific dimensions have been set forth for the exemplary embodiments shown in the drawings, it should be appreciated that other types of presses may require that the spacing and width of the recesses 100 be altered to suit the particular press. It is important to note that in selecting the particular spacing and width of the recesses 100, the effective air inlet area into the vacuum chamber upper portion 44A should be made to have approximately the same or greater effective area as that of the vacuum chamber lower portion 44B so that the air flow volume through the upper portion is substantially greater, preferably approximately twice that of the air flow volume through the lower portion. This will insure that the sheet 12 will be smoothly and uniformly drawn rapidly onto the vacuum transfer apparatus 10 as it is initially pulled from the impression cylinder 14 so that the printed side of the sheet can not contact any other apparatus in the press.

Moreover, while the exemplary embodiments have been presented in the context of a press having a transfer conveyor 20 employing chains 22 and gripper bars 28, the vacuum transfer apparatus 10 can equally be used with presses having other types of transfer conveyors since the vacuum transfer apparatus 10 of the invention will prevent the wet inked side of a sheet 12 from coming into contact with other press apparatus such as transfer wheels and cylinders. Thus, when used for example in a perfecting type press, the vacuum transfer apparatus 10 can be installed to supplement the existing transfer system without requiring removal of the existing transfer system. In such a case, the vacuum transfer apparatus 10 can be used when ever one sided sheet printing is to be done, and than deactivated when the press is used in the perfector mode for two sided sheet printing.

Further, it should be apparent that the principles of the present invention can be adopted for use in various types of rotary sheet fed presses, and that one or more vacuum transfer apparatus can be used in such presses in the transfer or delivery station or both. Moreover, while the foregoing discussion has been directed to the use of a plurality of support rollers, in very small rotary sheet fed presses it may be possible to employ the principles of the invention with only a single rotatably mounted support roller with the air flow into the vacuum chamber being around the roller through the spaces between the roller and the supporting frame of the vacuum chamber.

Those skilled in the art will appreciate that a variety of changes and modifications to the present invention can be made without departing from the spirit and scope of the invention as defined by the appended claims.

We claim:

1. In combination with a rotary sheet fed off-set printing press including a plurality of spaced processing stations each interconnected by a sheet transfer means for transferring sheets downstream along a transfer path from one processing station to the next, said processing stations including at least one upstream sheet printing station and a downstream sheet delivery station with each printing station having a blanket cylinder and an impression cylinder extending laterally within the press and arranged to apply wet ink to one side of a sheet moving downstream through the press, at least one of said sheet transfer means including a transfer conveyor having means for gripping and pulling a freshly printed sheet from the impression cylinder and moving said sheet downstream along said transfer path to the next processing station of the press, a vacuum transfer apparatus comprising:

a frame defining an upwardly open sided vacuum chamber having a leading end and a trailing end and defining therebetween an upstream chamber portion and a downstream chamber portion, said

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frame being disposed to extend laterally across said transfer path below said transfer conveyor with said leading end closely adjacent said impression cylinder;

a plurality of elongated generally cylindrical support rollers rotatably mounted to said frame overlying said upwardly open side of said vacuum chamber between said leading and trailing ends and arrayed in closely spaced side-by-side relation with adjacent sides of said rollers defining therebetween air inlet spaces to said vacuum chamber;

means communicating with said vacuum chamber for creating a negative pressure within said chamber to cause air to flow through said air inlet spaces between said rollers into said chamber for drawing the unprinted side of a sheet being moved by said transfer conveyor along said transfer path into engagement with said support rollers; and

means for producing a differential air flow into said vacuum chamber between said leading and trailing ends by causing a substantially greater volume of air flow into said upstream chamber portion than the air flow into said downstream chamber portion, whereby said differential air flow causes said sheet to be drawn more firmly into engagement with said rollers overlying said upstream chamber portion than into engagement with said rollers overlying said downstream chamber portion.

2. A vacuum transfer apparatus as set forth in claim 1 wherein said means for producing said differential air flow includes means providing a substantially greater air inlet space between said support rollers overlying said upstream chamber portion of said vacuum chamber than the air inlet space defined between said support rollers overlying said downstream chamber portion.

3. A vacuum transfer apparatus as set forth in claim 2 wherein said support rollers include at least one roller having an enlarged diameter, said at least one roller overlying said upstream chamber portion of said vacuum chamber.

4. A vacuum transfer apparatus as set forth in claim 3 wherein said greater air flow spacing is formed by annular recesses spaced along the length of said at least one roller.

5. A vacuum transfer apparatus as set forth in claim 4 wherein said annular recesses are formed to provide approximately twice the air flow into said upstream chamber portion of said vacuum chamber than that into said downstream chamber portion of said vacuum chamber.

6. A vacuum transfer apparatus as set forth in claim 5 wherein said means for creating said negative pressure includes a vacuum producing pump coupled in flow communication with said vacuum chamber.

7. A vacuum transfer apparatus as set forth in claim 6 wherein each of said support rollers is mounted to said frame for free rotation about its longitudinal axis.

8. A vacuum transfer apparatus as set forth in claim 7 wherein each of said support rollers is mounted to said frame by bearings and axles.

9. A vacuum transfer apparatus as set forth in claim 6 including means for rotatably driving said support rollers in timed relation with the downstream movement of said sheet along said transfer path.

10. A vacuum transfer apparatus as set forth in claim 4 wherein said at least one roller comprises three such rollers, and said annular recesses are formed to provide approximately twice the air flow into said upstream chamber portion of said vacuum chamber than the air flow into said downstream chamber portion of said vacuum chamber.

11. A vacuum chamber apparatus as set forth in claim 10 wherein the minimum spacing between each support roller of said array is approximately 1/16 inch.

12. A vacuum transfer apparatus as set forth in claim 2 wherein said means for producing said differential air flow comprises providing annular recesses in the surfaces of said support rollers overlying said upstream chamber portion of said vacuum chamber.

13. A vacuum transfer apparatus as set forth in claim 12 wherein said greater air inlet space is formed to produce approximately twice the air flow into said upstream chamber portion than that into said downstream chamber portion of said vacuum chamber.

14. A vacuum transfer apparatus as set forth in claim 13 wherein each of said support rollers is mounted to said frame for free rotation about its longitudinal axis.

15. A vacuum transfer apparatus as set forth in claim 13 including means for rotatably driving said support rollers in timed relation with the downstream movement of said sheet along said transfer path.

16. A vacuum transfer apparatus as set forth in claim 15 wherein said substantially greater air inlet space is formed by annular recesses provided at spaced intervals along the length of said at least one roller.

17. A vacuum transfer apparatus as set forth in claim 1 including means for segmenting said vacuum chamber below said rollers into said upstream portion and said downstream portion, said segmented upstream chamber portion having a substantially smaller chamber area than the area of said segmented downstream chamber portion.

18. In combination with a rotary sheet fed off-set printing press including a plurality of spaced processing stations each interconnected by a sheet transfer means for transferring sheets along a transfer path extending downstream from one processing station to the next, said processing stations including at least one upstream sheet printing station and a downstream sheet delivery station with each printing station having a blanket cylinder and an impression cylinder extending laterally within the press and arranged to apply wet ink to one side of a sheet moving downstream through the press, at least one of said sheet transfer means including a transfer conveyor having means for gripping and pulling a freshly printed sheet from the impression cylinder and moving said sheet downstream along said transfer path to the next processing station of the press, a vacuum transfer apparatus comprising:

a frame having leading and trailing end walls and laterally spaced side walls interconnected with a rear wall to define an upwardly open sided vacuum chamber, and including means defining an initial chamber portion and a final chamber portion, said frame being disposed with said leading end wall positioned closely adjacent said impression cylinder and extending laterally across a portion of said transfer path below said transfer conveyor;

a plurality of elongated generally cylindrical support rollers mounted to said frame side walls in closely spaced side-by-side parallel relation to extend laterally over said upwardly open side of said vacuum chamber and across said transfer path, the spaces between adjacent rollers defining elongated air inlet spaces through which air can flow into said

vacuum chamber, said rollers each being mounted for rotation about its respective longitudinal axis;

means communicating with said vacuum chamber for producing a negative pressure within said chamber to draw air around said rollers through said air inlet spaces into said chamber thereby to draw the unprinted side of a freshly printed sheet into engagement with said support rollers as said sheet is pulled from said impression cylinder and moved along said transfer path by said transfer conveyor; and

means for providing a substantially greater volume of air flow into said initial chamber portion than the air flow into said final chamber portion to draw said sheet more firmly into engagement with said rollers overlying said initial chamber portion than into engagement with said rollers overlying said final chamber portion.

19. A vacuum transfer apparatus as set forth in claim 18 wherein said means for providing said greater air flow includes providing a substantially greater inlet spacing between said support rollers overlying said initial chamber portion of said vacuum chamber than the inlet spacing defined between the support rollers overlying said final chamber portion.

20. A vacuum transfer apparatus as set forth in claim 19 wherein said support rollers overlying said initial vacuum chamber portion have annular recesses spaced along their length to form said greater spacing.

21. A vacuum transfer apparatus as set forth in claim 20 wherein said support rollers overlying said initial vacuum chamber portion have a diameter greater than said support rollers overlying said final vacuum chamber portion.

22. A vacuum transfer apparatus as set forth in claim 21 wherein said recesses are dimensioned to produce approximately twice the air flow into said initial vacuum chamber portion than that into said final vacuum chamber portion.

23. A vacuum transfer apparatus as set forth in claim 22 wherein the minimum spacing between each of said plurality of support rollers is approximately 1/16 inch.

24. A vacuum transfer apparatus as set forth in claim 23 wherein said means for creating said negative pressure includes a vacuum producing pump coupled in flow communication with said vacuum chamber.

25. A vacuum transfer apparatus as set forth in claim 23 wherein each of said support rollers is mounted to said frame for free rotation about its longitudinal axis.

26. A vacuum transfer apparatus as set forth in claim 21 wherein each of said support rollers is mounted to each of said side walls by a sealed bearing and axle.

27. A vacuum transfer apparatus as set forth in claim 26 wherein said recesses in said large diameter support rollers are spaced to permit the transfer conveyor gripping means to pass freely over said rollers.

28. A method of supporting a freshly printed sheet during a downstream transfer of the sheet from an impression cylinder of a sheet fed rotary printing press to a further downstream processing station of the press comprising the steps of:

gripping the leading edge of the freshly printed sheet as it emerges from the impression cylinder and pulling the sheet therefrom;

conveying the freshly printed sheet downstream along a transfer path such that the unprinted side of the sheet passes over a vacuum chamber having a plurality of rotatable support rollers disposed laterally across the transfer path in overlying relation with said chamber and arrayed in closely spaced side-by-side relation;

applying a negative pressure to the vacuum chamber to produce a flow of air into the chamber around the support rollers to draw the sheet into engagement with the support rollers as the sheet is conveyed downstream over the vacuum chamber; and

creating a substantially greater flow of air into the chamber around the support rollers overlying an upstream portion of the chamber than the flow of air around the rollers overlying the portion of the chamber downstream of the upstream portion, whereby the unprinted side of the sheet is drawn more firmly into engagement with the support rollers overlying the upstream chamber portion than into engagement with the support rollers overlying the portion of the chamber downstream of the upstream portion as the sheet is conveyed along the transfer path.

29. The method as set forth in claim 28 wherein said greater flow of air is created by drawing a larger volume of air around the support rollers overlying said upstream chamber portion of the vacuum chamber than that drawn around the support rollers overlying the portion of the chamber downstream of the upstream portion.

* * * * *

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US005176077A

United States Patent [19]

DeMoore et al.

[11] **Patent Number:** **5,176,077**

[45] **Date of Patent:** **Jan. 5, 1993**

[54] **COATING APPARATUS FOR SHEET-FED, OFFSET ROTARY PRINTING PRESSES**

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[73] Assignee: **Howard W. DeMoore**, Dallas, Tex.

[21] Appl. No.: **752,778**

[22] Filed: **Aug. 30, 1991**

[51] **Int. Cl.**[5] **B41F 9/00**

[52] **U.S. Cl.** **101/142**; 101/147; 101/232; 101/348; 118/46

[58] **Field of Search** .... 101/135, 424.1, 142, 101/148, 155, 157, 177, 217, 232, 246, 329, 330, 331, 408, 409, 419, 422, 348-349; 118/46, 211, 236, 249, 257, 258, 261, 262, 263, 206, DIG. 15

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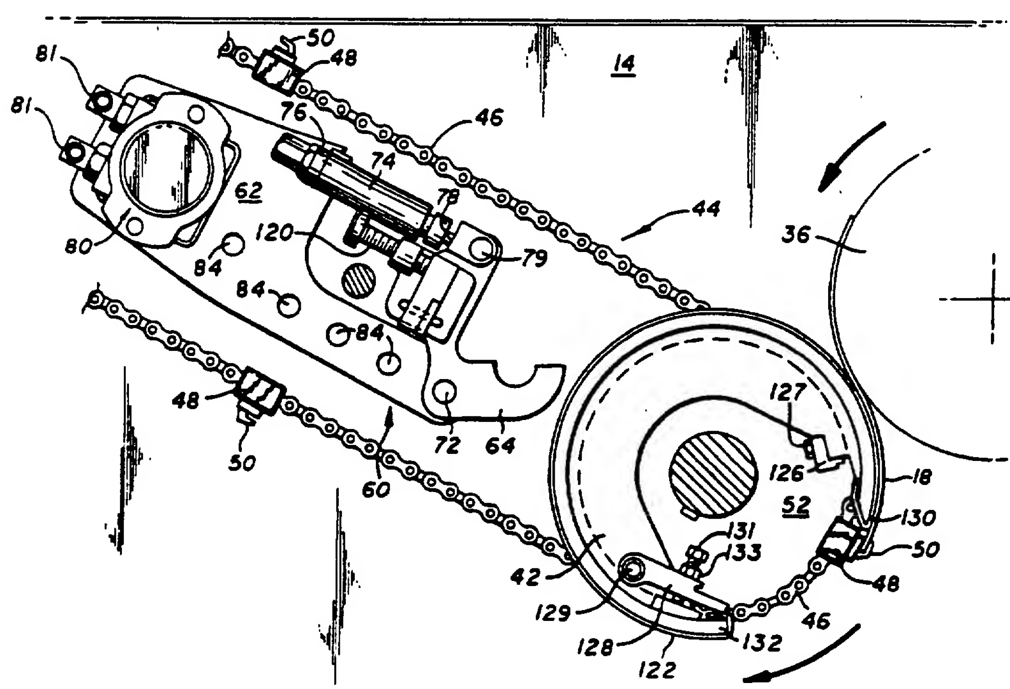
Attorney, Agent, or Firm—Dennis T. Griggs

[57] **ABSTRACT**

A coating apparatus for use in a sheet-fed, offset rotary printing press to selectively apply a protective and/or decorative coating to the wet ink surface of freshly printed sheets and including a coating unit having a pick-up roller for supplying aqueous coating material from a reservoir to the surface of a delivery cylinder mounted on a press delivery drive shaft, the delivery cylinder performing the dual function of a coating applicator roller and a delivery cylinder during coating operations.

22 Claims, 5 Drawing Sheets



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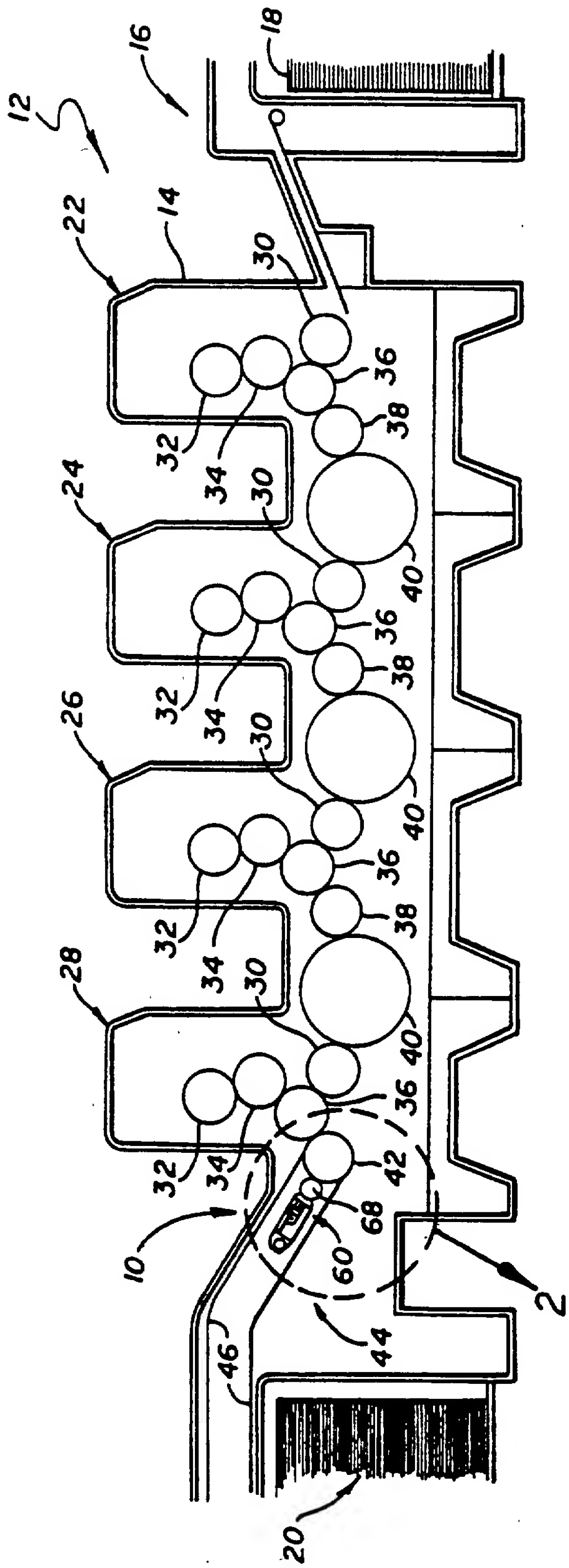

FIG. 1

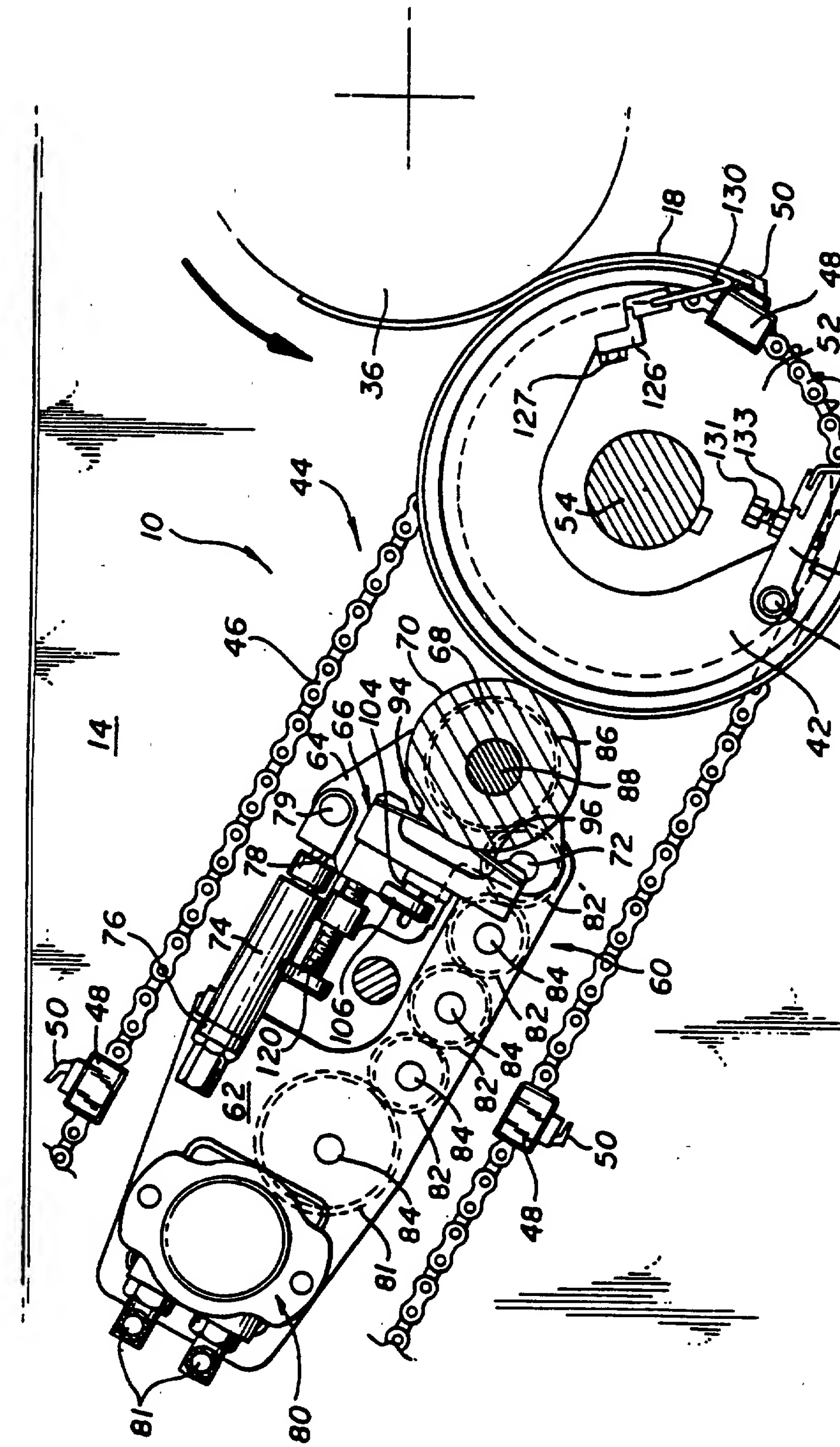

FIG. 2

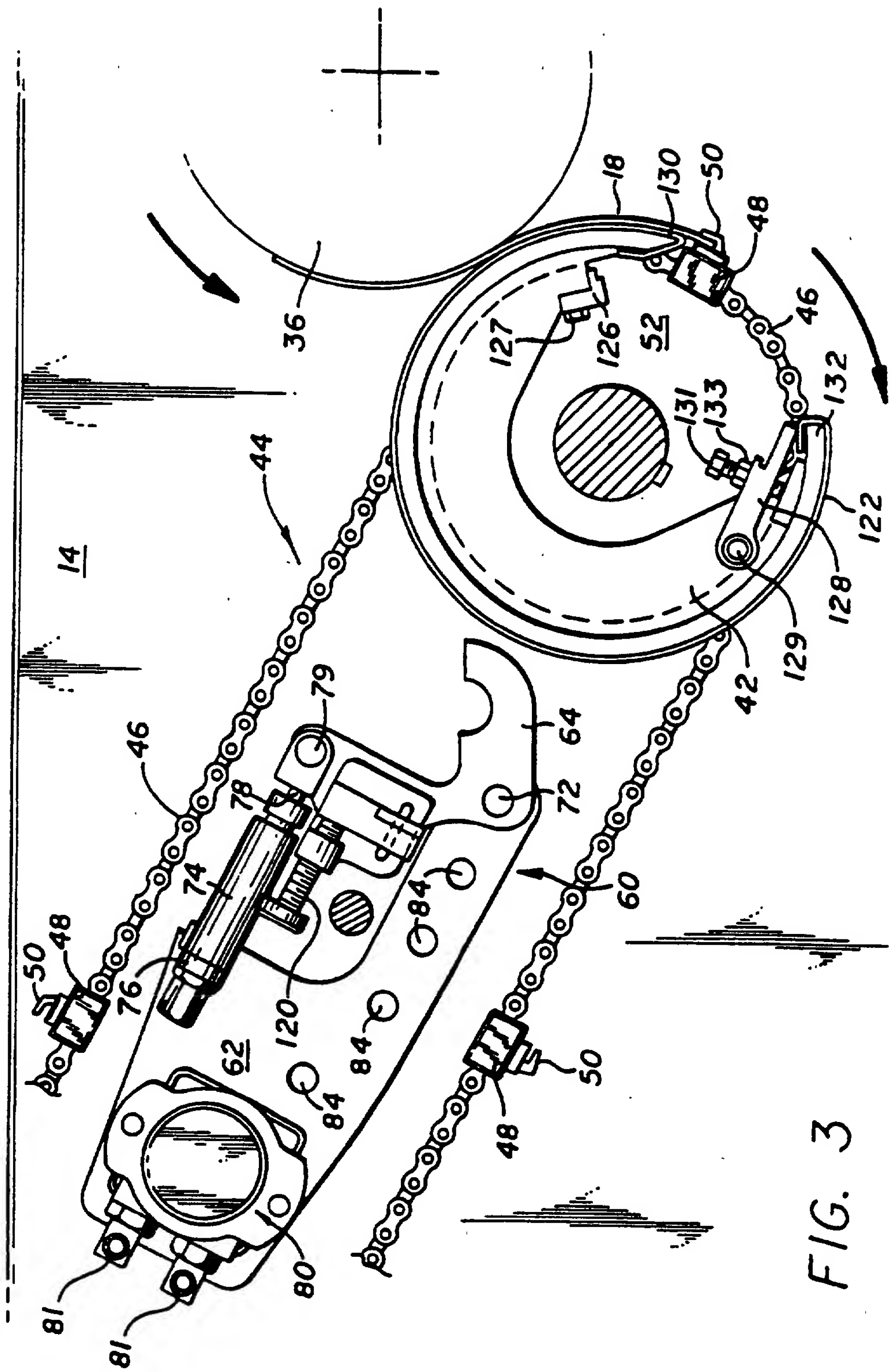
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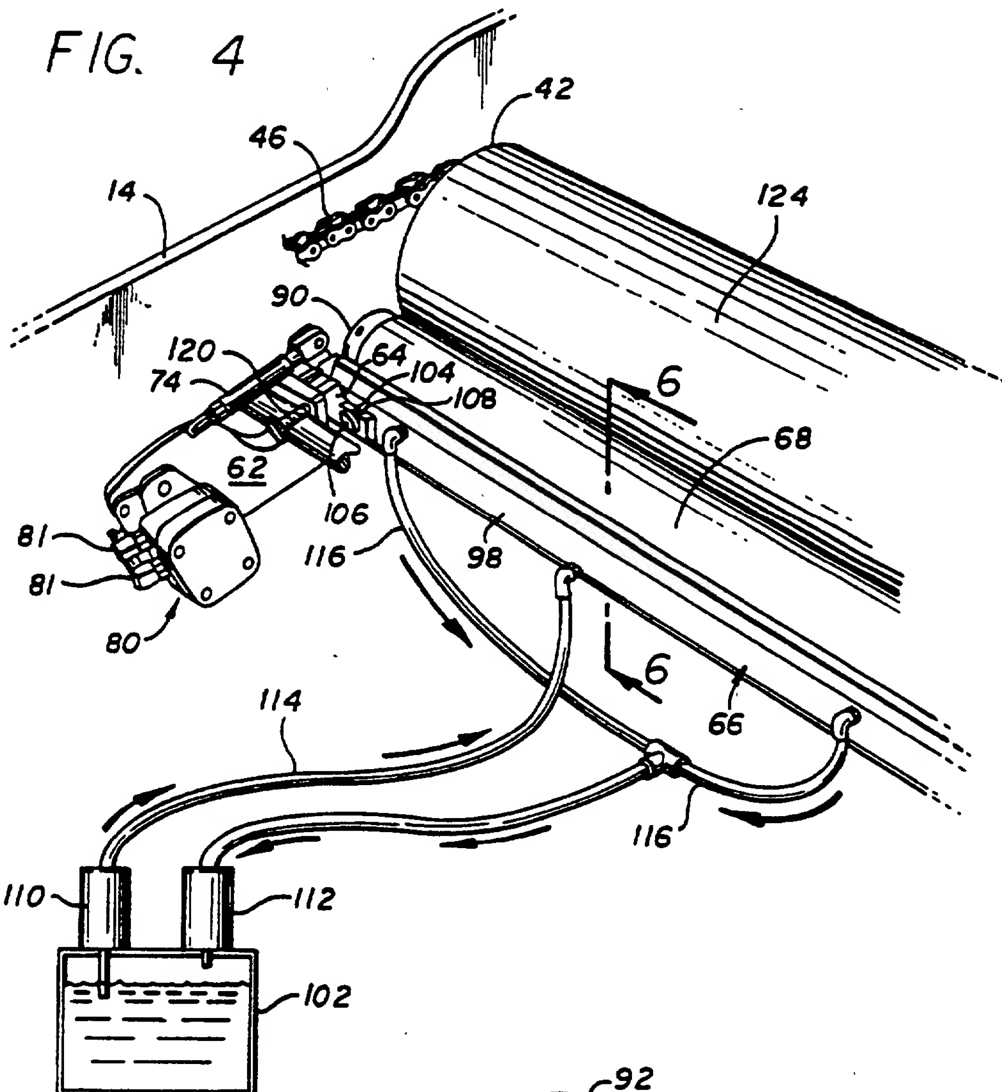
FIG. 3

FIG. 4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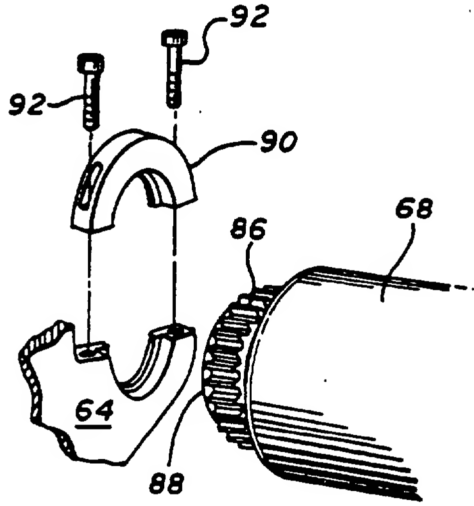
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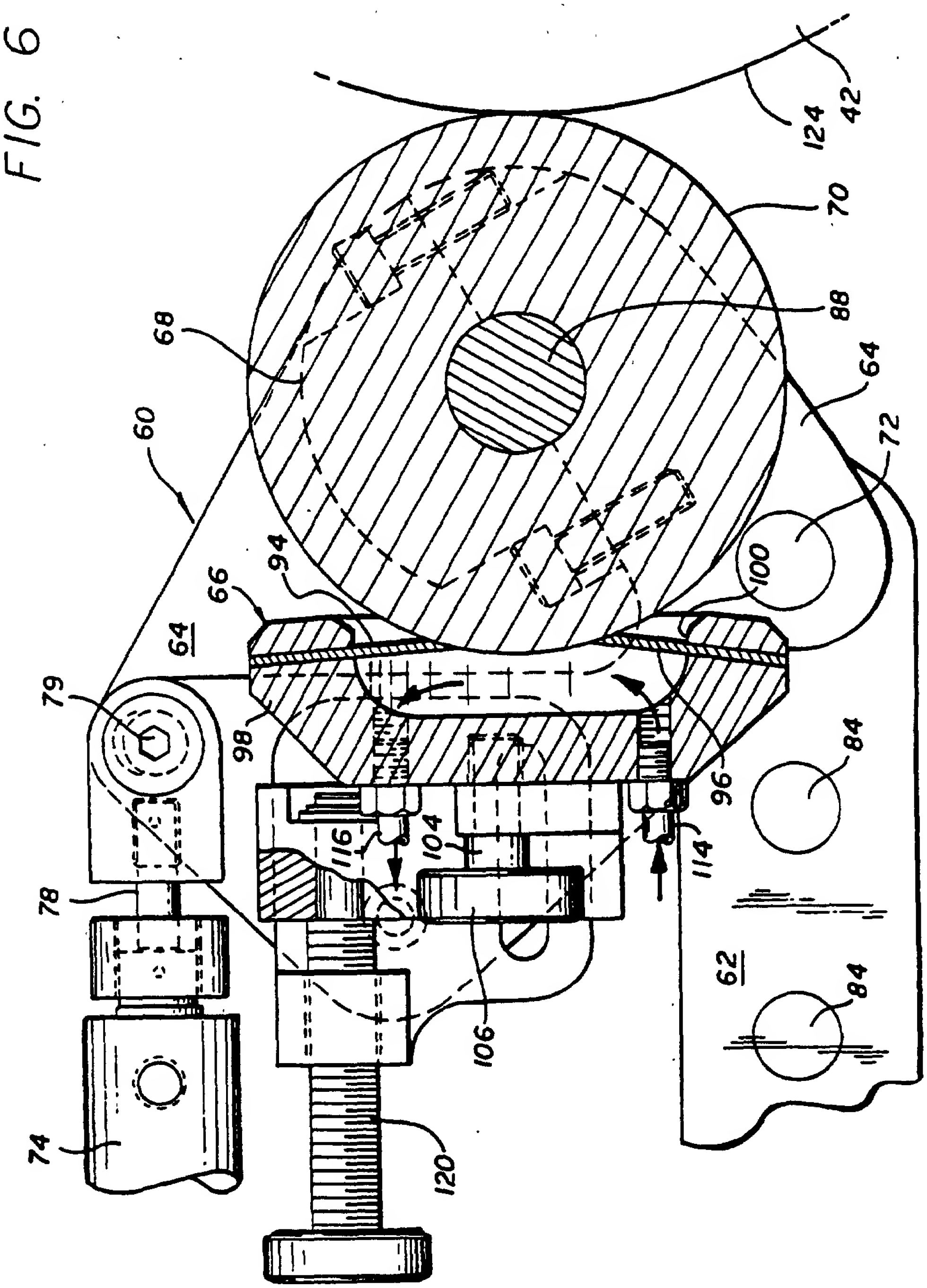
FIG. 5

FIG. 6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COATING APPARATUS FOR SHEET-FED, OFFSET ROTARY PRINTING PRESSES

BACKGROUND OF THE INVENTION

This invention relates to sheet-fed, offset rotary printing presses, and more particularly, to a new and improved apparatus for the in-line application of protective and decorative coatings to the printed surface of freshly printed sheets.

Conventional sheet-fed, offset rotary printing presses typically include one or more printing stations through which individual sheets are fed and printed with wet ink. After final printing, the sheets are fed by a delivery conveyor system to the delivery end of the press where the freshly printed sheets are collected and stacked. In a typical sheet-fed, offset rotary printing press such as the Heidelberg Speedmaster line of presses, the delivery conveyor system includes a pair of endless gripper chains carrying laterally spaced gripper bars and grippers which are used to grip and pull freshly printed sheets from the impression cylinder and convey the sheets toward the sheet delivery stacker. The gripper chains are driven in precisely timed relation to the impression cylinder by gripper chain sprocket wheels laterally spaced between a delivery drive shaft mounted on opposite sides of the press frame, the delivery drive shaft being mechanically coupled by gears for synchronous rotation with the impression cylinder.

Since the inks used with offset type printing presses typically remain wet and tacky for some time after printing, special precautions must be taken to insure that the wet inked surface of the freshly printed sheets are not marked or smeared as the sheets are transferred from one printing station to another, and through the delivery system to the sheet delivery stacker. One system for insuring that the freshly printed sheets are not marked or smeared during transfer is the transfer or delivery cylinder system marketed by Printing Research, Inc., of Dallas, Texas under its registered trademark "SUPER BLUE" That system, which is made and sold under license, is made in accordance with and operates as described in U.S. Pat. No. 4,402,267, issued Sep. 6, 1983 to Howard W DeMoore, the disclosure of which is incorporated herein by this reference. In that system, marking and marring of freshly printed sheets is prevented by employing transfer or delivery cylinders provided with a coating of friction reducing material such as PTFE (Teflon) over which are loosely mounted fabric covers, referred to in the trade as "nets", and which support the wet ink side of the freshly printed sheets as they are pulled from the impression cylinder. Typically, in a multi-color press employing the "SUPER BLUE" cylinder system, each transfer cylinder for conveying the freshly printed sheets from one printing station to the next is supplied with a "SUPER BLUE" transfer cylinder system, and the delivery cylinder for conveying the sheets from the last printing station to the sheet delivery stacker is supplied with a "SUPER BLUE" delivery cylinder system. As used hereinafter, the term "net type cylinder" is intended to refer to cylinders having fabric nets disposed over the support surface, such as of the general type disclosed in the aforementioned DeMoore U.S. Pat. No. 4,402,267 and exemplified by the "SUPER BLUE" cylinder system.

Another system which can be used to prevent marking and smearing of the freshly printed sheets is that disclosed in U.S. application Ser. No. 07/630,308 filed Dec. 18, 1990 entitled Vacuum Transfer Apparatus for Sheet-Fed Printing Presses now U.S. Pat. No. 5,127,329. That application, the disclosure of which is also incorporated herein by reference, discloses an apparatus which can be employed to draw the unprinted side of a freshly printed sheet into engagement with rollers which support the sheet on the unprinted side during transfer or delivery of the sheet from the impression cylinder after printing so that the wet ink on the freshly printed sheet does not come in contact with other apparatus in the press. The vacuum transfer apparatus disclosed in that application can be used as an alternative to the net type cylinder system disclosed in the aforementioned DeMoore patent, or when used in a perfecting press, as a supplement to that system, the vacuum transfer apparatus being primarily intended for use when only one-sided sheet printing is being performed by the press, and the net type cylinder system being used when the press is operating in the perfector mode with two-sided sheet printing.

In some printing applications, it is desirable that the press be capable of applying a protective and/or decorative coating over all or a portion of the surface of the printed sheets. Such coatings typically are formed of a UV-curable or water-soluble resin applied as a liquid solution or emulsion by an applicator roller over the freshly printed sheets to protect the ink and improve the appearance of the sheets. Use of such coatings is particularly desirable when decorative or protective finishes are required such as in the production of posters, record jackets, brochures, magazines, folding cartons and the like. In cases where a coating is to be applied, the coating operation is carried out after the final ink printing has been performed, most desirably by an in-line coating application, rather than as a separate step after the printed sheets have been delivered to the sheet delivery stacker.

Various suggestions have been made for applying the coating as an in-line press operation by using the final printing station of the press as the coating application station. For example, in U.S. Pat. Nos. 4,270,483, 4,685,414, and 4,779,557 there are disclosed coating apparatus which can be moved into position to allow the blanket cylinder of the last printing station of a press to be used to apply a coating material to the sheets. In U.S. Pat. No. 4,796,556 there is disclosed a coating apparatus which can be selectively moved between the blanket cylinder or the plate cylinder of the last printing station of the press so that that station can be used as a coating station for the press. However, when coating apparatus of these types are used, the last printing station can not be used to apply ink to the sheets, but rather can only be used for the coating operation. Thus, with these types of in-line press coating apparatus, the press loses the capability of printing its full range of colors since the last printing station is converted to a coating station.

Suggestions for overcoming the problem of the loss of a printing station when coating is desired have also been made, such as that set forth in U.S. Pat. Nos. 4,934,305 which discloses a coating apparatus having a separate timed applicator roller positioned to apply the coating material to the printed sheet while the sheet is on the last impression cylinder of the press. This is said to allow the last printing station to be operated simultaneously as both an ink application station and a coating

station so that no loss of press printing unit capability results. Another approach to providing a coating station without loosing the printing capabilities of the last printing station is to provide a totally separate coating unit down stream of the last printing station so that the coating is applied to the sheets after final printing and before the sheets have reached the sheet delivery stacker. Such an approach is suggested in U.S. Pat. Nos. 4,399,767 and 4,706,601. While each of these suggestions provide coating stations which allow the final printing station to continue to be used for printing, they each suffer from the disadvantages of requiring the provision of separately driven coating applicator rollers and apparatus which must be precisely timed in relation to the movement of the sheet to be coated so as to insure precise registration between application of the coating material and the printed sheet. The provision of separate timed applicator rollers require that the presses be modified to provide sufficient space within the presses to accommodate the added coating apparatus or to increase the length of the presses, and require additional and complex drive connections with the press drive system to achieve the required precise speed correlation between the sheets and the applicator rollers. Such modifications can be both expensive and cumbersome to install and maintain.

Thus, there exists a need for a new and improved in-line apparatus for use in a sheet-fed, offset rotary printing press to selectively apply a protective and/or decorative coating to the printed surface of freshly printed sheets which allows the final press printing station to continue to be used as a printing station, yet which does not require any substantial press modification or the addition of a separate timed applicator roller. As will be explained in more detail hereinafter, the present invention solves this need in an novel and unobvious manner.

SUMMARY OF THE INVENTION

The present invention provides a new and improved in-line apparatus for selectively applying a protective and/or decorative coating to the surface of freshly printed sheets in a sheet-fed, offset rotary printing press which is highly reliable and effective in use, yet which does not require any expensive or substantial press modification or result in any impairment of normal press operating capability. The present invention enables the press to be used to selectively apply the coating material to the freshly printed sheets as the sheets are conveyed from the impression cylinder of the last printing station of the press toward the sheet delivery stacker by utilizing a delivery cylinder mounted to the existing press delivery drive shaft to perform the dual function of a coating material applicator roller and a sheet delivery cylinder so that no modification of the press is required to enable the press to be used for either coating or noncoating operation, and without impairment of any normal press operations.

More specifically, the present invention is intended for use in a sheet-fed, offset rotary printing press of the type having at least one printing station which includes a blanket cylinder and an impression cylinder disposed for printing ink onto sheets passing therebetween, and a delivery conveyor system for pulling freshly printed sheets off the impression cylinder and transporting the sheets toward the press sheet delivery stacker. For use of the present invention, the press must include a delivery drive shaft disposed adjacent to and extending parallel with the impression cylinder, and which is driven in timed synchronous relation with the impression cylinder.

In accordance with the invention, a delivery cylinder is mounted to the delivery drive shaft and provided with a coating blanket disposed over the peripheral outer surface of the cylinder, and adapted to engage and support the wet ink side of a freshly printed sheet. A coating apparatus including a supply of liquid coating material and a pick-up roller disposed to receive coating material from the supply, is mounted to the press and operable to permit the pick-up roller to be moved into engagement with the delivery cylinder so that coating material on the pick-up roller is transferred to the coating blanket of the delivery cylinder and then to the freshly printed sheet.

Preferably, the coating apparatus is mounted to the press downstream of the delivery drive shaft, and includes means to selectively move the pick-up roller into and out of engagement with the delivery cylinder. When the pick-up roller is not in the operable position in engagement with the delivery cylinder, the delivery cylinder can be used for conventional noncoating sheet delivery by removing the coating blanket and, preferably, replacing the coating blanket with a fabric net such as of the net type cylinder system previously described. To convert to a coating operation, the coating blanket is attached to the delivery cylinder and, depending upon the thickness of the sheets to be printed, packed with suitable packing sheets to increase the effective diameter of the cylinder so that pressure is applied to the freshly printed sheets against the impression cylinder by the coating blanket covered delivery cylinder. The pick-up roller is then moved to the operative position engaged with the delivery cylinder so that as freshly printed sheets are pulled by the delivery conveyor from the impression cylinder around the delivery cylinder, coating material applied to the delivery cylinder by the pick-up roller is transferred to the freshly printed sheets in the nip between the delivery cylinder and the impression cylinder.

Since the delivery cylinder is driven by the delivery drive shaft in precise timed relation with the impression cylinder, exact registration between the application of coating material and the printed sheet is assured. Further, since the coating of the freshly printed sheets is carried out through use of a delivery cylinder mounted to the existing press delivery drive shaft, no substantial press modifications are required, and the press can be quickly and easily converted between coating and noncoating operation with no loss of printing capability of the final printing station.

Many other features and advantages of the present invention will become more apparent from the following detailed description take in conjunction with the accompanying drawings which disclose, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side elevational view of a sheet-fed, offset rotary printing press having a coating apparatus embodying the present invention;

FIG. 2 is an enlarged fragmentary side elevational view taken substantially within the circular area designated "2" in FIG. 1 and showing the coating apparatus of the present invention during coating operation;

FIG. 3 is a side elevational view similar to FIG. 2, but showing the coating apparatus in the inoperative posi-

tion with the coating pick-up roller and reservoir removed, and the blanket covering over the delivery cylinder replaced with a fabric net for non-coating printing;

FIG. 4 is an enlarged fragmentary perspective view showing one side of the coating apparatus mounted in the press and illustrating the fluid path of coating material from a supply tank to the reservoir of the coating unit;

FIG. 5 is an enlarged fragmentary perspective view illustrating the end mounting of the coating pick-up roller to its support bracket; and

FIG. 6 is an enlarged fragmentary sectional view taken substantially along the lines 6—6 of FIG. 4.

DETAILED DESCRIPTION OF PRESENTLY PREFERRED EMBODIMENT

As shown in the exemplary drawings, the present invention is embodied in a new and improved in-line apparatus, herein generally designated 10, for selective use in applying a protective and/or decorative coating to the freshly printed surface of sheets printed in a sheet-fed, offset rotary printing press, herein generally designated 12. In this instance, as shown in FIG. 1, the coating apparatus 10 is illustrated as installed in a four color printing press 12, such as that manufactured by Heidelberger Druckmaschinen AG of the Federal Republic of Germany under its designation "Heidelberg Speedmaster 102V (40")," and which includes a press frame 14 coupled at one end, herein the right end, with a sheet feeder 16 from which sheets, herein designated 18, are individually and sequentially fed into the press, and at the opposite end, with a sheet delivery stacker 20 in which the finally printed sheets are collected and stacked. Interposed between the sheet feeder 16 and the sheet delivery stacker 20 are four substantially identical sheet printing stations 22, 24, 26 and 28 which can print different color inks onto the sheets as they are moved through the press 10.

As illustrated, each of the printing stations 22, 24, 26 and 28 is substantially identical and of conventional design, herein including a sheet feed cylinder 30, a plate cylinder 32, a blanket cylinder 34 and an impression cylinder 36, with each of the first three printing stations 22, 24, and 26 having a transfer cylinder 38 disposed to withdraw the freshly printed sheets from the adjacent impression cylinder and transfer the freshly printed sheets to the next printing station via a transfer drum 40. The final printing station 28 herein is shown as equipped with a delivery cylinder 42 which functions to support the printed sheet 18 as it is moved from the final impression cylinder 36 by a delivery conveyor system, generally designated 44, to the sheet delivery stacker 20.

The delivery conveyor system 44 herein is of conventional design and includes a pair of endless delivery gripper chains 46, only one of which is shown in the drawings, carrying at regular spaced locations along the chains, laterally disposed gripper bars 48 having gripper elements 50 used to grip the leading edge of a sheet 18 after it leaves the nip between the delivery cylinder 42 and impression cylinder 36 of the last printing station 28. As the leading edge of the sheet 18 is gripped by the grippers 50, the delivery chains 46 pull the sheet away from the impression cylinder 36 and convey the freshly printed sheet to the sheet delivery stacker 20 where the grippers release the finally printed sheet. The endless delivery chains 46 are driven in synchronous timed relation to the impression cylinder 36 by sprocket wheels 52 fixed adjacent the lateral ends of a delivery drive shaft 54 which has a mechanically geared coupling (not shown) through the press drive system to the impression cylinder. The delivery drive shaft 54 extends laterally between the sides of the press frame 14 adjacent the impression cylinder 36 of the last printing station 28, and is disposed to be parallel with the axis of the impression cylinder. In this instance, the delivery cylinder 42, which is constructed to allow adjustments in diameter by suitable means, is fixedly mounted to the delivery drive shaft 54 so that the delivery cylinder is also rotated in precise timed relation to the impression cylinder.

Preferably, each of the transfer cylinders 38 is equipped with an anti-marking system such as the aforementioned net type transfer cylinder system or the press 12 can be supplied in the transfer positions with vacuum transfer systems of the type disclosed in the above-identified copending U.S. application Ser. No. 07/630,308 filed Dec. 18, 1990, although as will become more apparent hereinafter, the use of such transfer systems is not required for the present invention and other types of transfer systems can be used. For reasons that will become more apparent hereinafter, for most effective use of the present invention, however, the delivery cylinder 42 should be of the type which employs the "SUPER BLUE" delivery cylinder system, or, as an alternative, should employ in the delivery position, a vacuum transfer system such as disclosed in the above-identified copending U.S. application Ser. No. 07/630,308.

In this respect, it is important to note that when the freshly printed sheets 18 are conveyed away from the impression cylinder 36 of the final printing station 28 by the gripper 50 carried by the delivery chains 46, the wet inked surfaces of the sheets face the delivery drive shaft 54 and the sheets must be supported such that the ink is not marked or smeared as the sheets are transferred. Typically, such support is provided by skeleton wheels or cylinders mounted to the press delivery drive shaft 54, or as is now more commonly used, net type delivery cylinders such as of the "SUPER BLUE" delivery cylinder system type disclosed in the aforementioned DeMoore patent. More recently, vacuum transfer apparatus of the type disclosed in the aforementioned copending U.S. application Ser. No. 07/630,308 have been used in place of delivery cylinders or skeleton wheels to pull the unprinted side of the sheet away from the delivery drive shaft 54 so that the wet ink surface of the sheets do not come into contact with any press apparatus. It has been found, however, that when a protective or decorative coating material is applied to the wet ink surface of the sheets, the coating protects the wet ink against marking and smearing such that the coating applicator roller itself can be used to support the wet inked surface of the sheets without fear of damage to the freshly printed surface.

In accordance with the present invention, the in-line coating apparatus 10 for selectively applying the protective or decorative coating to the sheets 18 enables the press 12 to be operated in the normal manner without the loss of the final printing station 28, and without requiring any substantial press modifications by employing the existing press delivery drive shaft 54 as the mounting location for the coating applicator roller. In presses 12 utilizing a net type delivery cylinder system, that system can be quickly and easily converted to perform the dual function of being a coating applicator roller and a delivery cylinder. In presses having other

types of delivery systems such as skeleton wheels mounted on the delivery drive shaft 54 or a vacuum transfer apparatus as disclosed in the aforementioned copending U.S. application Ser. No. 07/630,308, conversion to a coating operation can be quickly and easily achieved by mounting on the press delivery drive shaft in place of the skeleton wheels or in addition to the vacuum transfer apparatus, a suitable support cylinder capable of performing the combined function of a coating applicator roller and a delivery cylinder 42. Typically, such a support cylinder will have a diameter which provides no more than about a 0.090 inch clearance between the cylinder support surface and the adjacent impression cylinder 36. By utilizing the delivery cylinder 42 mounted on the delivery drive shaft 54 to also act as a coating applicator roller, the present invention insures that the coating will be applied to the printed sheet 18 in precise timed registration, and will permit the press to be operated with its full range of printing stations, yet allow fast, simple and convenient change-over from coating to noncoating operations, and vice versa, with a minimum of press down time.

Toward these ends, the coating apparatus 10 of the present invention includes a relatively simple, positive acting and economical coating unit, generally designated 60, mounted to the press frame 14 down stream of the delivery drive shaft 54 and positioned to selectively supply coating material to the support surface of a delivery cylinder 42 mounted on the delivery drive shaft. As best can be seen in FIGS. 2, 4 and 6, the coating unit 60 herein comprises a pair of side frames 62, only one of which is shown, it being understood that the other side frame is substantially the same as that of the side frame illustrated, attached to each side of the press frame 14. Pivotally mounted to one end of each of the side frames 62 is a support bracket 64 carrying one end of a coating material reservoir 66 and cooperating coating material pick-up roller 68 each disposed to extend laterally across the press 12 parallel with the delivery drive shaft 54. The coating unit 60 is mounted between the upper and lower runs of the delivery chains 46 down stream of the delivery drive shaft 54, and positioned so that the outer peripheral surface 70 of the pick-up roller 68 can be frictionally engaged with the support surface of a delivery cylinder 42 mounted on the delivery drive shaft.

As best seen in FIGS. 2 through 4, the support bracket 64 is pivotally attached to the end of the side frame 62 by a shaft 72 disposed at the lower end portion of the bracket, and can be pivoted about the shaft by an extensible cylinder 74, herein shown as a hydraulic cylinder, one end 76 of which is secured such as by welding to the side frame, and the opposite end 78 of which is coupled through a pivot shaft 79 to the upper end portion of the bracket. By extending or retracting the cylinder 74, the extent of frictional engagement of the pick-up roller 68 with the surface of the delivery cylinder 42 can be controlled, and the pick-up roller can be completely disengaged from the delivery cylinder.

The coating pick-up roller 68, which can be of conventional design and preferably one such as the Anilox rollers manufactured by A.R.C. International of Charlotte, N.C., and sold under the name "PRINTMASTER" having an engraved ceramic or chrome outer peripheral surface 70, is designed to pick up a predetermined uniform thickness of coating material from the reservoir 66, and then uniformly transfer the coating to the support surface of the delivery cylinder 42. To effect rotation of the pick-up roller 68, a suitable motor 80, herein a hydraulic motor, is attached to one of the side frames 62 and coupled to a suitable hydraulic fluid source (not shown) through fittings 81. Attached to the output of the motor 80 is an output gear which is drivingly coupled through a reduction gear 81 and a series of idler gears 82 each mounted on stub axles 84, to a drive gear 86 attached to the end of a shaft 88 on which the pick-up roller 68 is concentrically mounted. The shaft 88 of the pick-up roller 68 is, in turn, journaled at each end to the brackets 64 through a releasable semicircular collar 90 (see FIG. 5) attached by bolts 92 to the bracket. Herein, the axle of the terminal idler gear, designated 82', also serves as the shaft 72 for pivotally mounting the support bracket 64 to the side frame 62 so that when the bracket is rotated about the shaft, the terminal idler gear remains engaged with the drive gear 86 of the pick-up roller 68.

In this instance, as best as can be seen in FIG. 6, the pick-up roller 68 has a portion which projects laterally into the reservoir 66 containing the supply of coating material, and a pair of upper and lower inclined doctor blades 94 and 96 attached to the reservoir engage the roller surface to meter the coating material picked up from the reservoir by the etched surface 70 of the roller. The reservoir 66 herein is formed by an elongated, generally rectangular housing 98 having a generally C-shaped cross-section with a laterally extending opening 100 along one side facing the pick-up roller 68, and is supplied with coating material from a supply tank 102 disposed in a remote location within or near the press 12. Preferably, the reservoir 66 is removably attached to the brackets 64, herein by bolts 104 having enlarged, knurled heads 106, and which can be threaded through slots 108 formed in the brackets to clamp the reservoir in place on the brackets.

To insure that an adequate supply of coating material is always present within the reservoir 66 and to prevent coagulation and clogging of the doctor blades 94 and 96 by the aqueous coating material, the coating material is circulated through the reservoir, herein by two substantially identical pumps 110 and 112, one of which pumps coating material from the supply tank 102 via a supply line 114 to the bottom of the reservoir, and the other of which acts to provide suction to a pair of return lines 116 coupled adjacent the top of the reservoir for withdrawing unused coating material from the reservoir. By circulating the coating material from the supply tank 102 at a greater rate than the rate of withdrawal of material by the pick-up roller 68, a substantially constant supply of coating material will always be present within the reservoir 66.

In this instance, the general arrangement of the pick-up roller 68, doctor blades 94 and 96, and reservoir 66 is substantially like that disclosed in U.S. Pat. No. 4,821,672 entitled DOCTOR BLADE ASSEMBLY WITH ROTARY END SEALS AND INTERCHANGEABLE HEADS", the disclosure of which can be reviewed for details concerning the structure and operation of a pick-up roller and reservoir usable with the present invention.

Once the coating unit 60 has been installed in a press 12, which basically only requires that the side frames 62 be attached, such as with bolts, to the sides of the press frame 14, and the hydraulic motor 80 be coupled with a suitable hydraulic source, the press can be quickly and easily converted to the coating mode. In presses 12 already supplied with a net type delivery cylinder sys-

tem, to convert to a coating operation, all that is necessary is that the fabric net material (designated 122 in FIG. 3) normally used over the support surface of the net type delivery cylinder during noncoating press operations, be removed and replaced with a coating blanket 124 capable of transferring coating material deposited thereon onto the printed sheets. Typically, such a blanket 124 can be formed as a rubber covering such as used for the covering surface of the conventional blanket cylinders 34 of the press 12. In presses 12 having conventional skeleton wheels or a vacuum transfer type apparatus such as that of the aforementioned copending U.S. application Ser. No. 07/630,308, a suitable delivery cylinder 42 can be fixed to the delivery drive shaft 54 and a similar coating blanket 124 applied thereto over the cylinder surface.

It is important to note that during nonprinting operations, the net type delivery cylinder 42 does not engage the surface of the impression cylinder 36 during sheet delivery. However, when used as a coating applicator roller during coating operations, the effective diameter of the delivery cylinder 42 must be increased so that the coating blanket 124 presses the sheet 18 against the surface of the impression cylinder 36, as shown in FIG. 2. To increase the effective diameter of the delivery cylinder 42, the thickness of the coating blanket 124 applied over the support surface of the delivery cylinder 42 can be selected to correspond with the thickness of the sheets 18 to be printed, or suitable packing sheets, such as paper sheets (not shown) of the type conventionally used in conjunction with press blanket cylinders 34, can be interposed between the delivery cylinder and the coating blanket.

While any suitable means can be used to attached the coating blanket 124 to the support surface of the delivery cylinder 42, in this instance, as shown in FIGS. 2 and 3, the delivery cylinder is supplied with clamps 126 attached by bolts 127 to the cylinder adjacent the leading edge 130 to secure the leading edge of the coating blanket 124 to the cylinder, and adjustable tensioning clamps 128 are provided adjacent the cylinder trailing edge 132 for securing the trailing edge of the blanket to the cylinder. However, the tensioning claims 128 are pivotally mounted at one end by a pin 129 to the cylinder 42, and the blanket tension is adjusted through a bolt 131 and nut 133 arrangement. Depending upon the thickness of the sheets 18 to be printed and coated by the press 12, one or more layers of packing paper or the like may be interposed between the support surface of the delivery cylinder 42 and the coating blanket 124 to increase the effective diameter of the cylinder. Provision of the tensioning clamps 128 for attaching the coating blanket 124 to the leading edge 132 of the delivery cylinder 42 allows for such control and adjustment.

Once installed, the coating unit 60 can remain in position even though the press 12 is operated in the non-coating mode. In this respect, when the coating unit 60 is not in operation, the extensible cylinder 74 can be actuated to pivot the support brackets 64 carrying the pick-up roller 68 and reservoir 66 about the shaft 72 and away from the delivery cylinder 42, thus rendering the coating unit inoperative. This then also frees the pick-up roller 68 and reservoir 66 for fast and easy removal from the coating unit 60 for cleaning, service or replacement. To remove the pick-up roller 68, the coating material is drained from the reservoir 66, and the pressure exerted by the doctor blades 94 and 96 against the roller is released, therein through operation of a pressure adjustment screw 120 attached to the reservoir, and the bolts 92 and collars 90 are removed, thereby permitting the pick-up roller to be lifted from the coating unit 60. To remove the reservoir 66, all that need be done is to release the mounting bolts 104 securing the reservoir to the brackets 64. With the coating unit 60 moved by the extensible cylinder 74 to the inoperative position, the delivery cylinder 42 can be converted for normal delivery cylinder operation simply by removing the coating blanket 124 from the delivery cylinder 42 and replacing the blanket with a fabric net 122. Alternatively, if a vacuum transfer apparatus such as described in the aforementioned copending U.S. application Ser. No. 07/630,308 is installed in the press 12, that apparatus can be activated to deliver sheets from the impression cylinder 36 without effecting any delivery cylinder change since the freshly printed side of the sheets will not come into contact with the delivery cylinder.

In a typical noncoating operation of the press 12 with the coating apparatus 10 installed, the coating unit 60 will be in the inoperative position. In that situation and with a net type delivery cylinder 42 installed, the delivery cylinder will be covered with the fabric net 122 so that the delivery cylinder operates in the normal manner with the wet ink side of the freshly printed sheets 18 being supported by the net covered surface of the delivery cylinder. Should the press 12 include a vacuum transfer apparatus such as disclosed in the aforementioned copending U.S. application Ser. No. 07/630,308, the delivery cylinder 42 can remain on the delivery drive shaft 54, with or without a fabric net 122, depending upon whether or not the press is used for perfector printing.

When it is desired to convert to the coating mode of operation, the press 12 is stopped just long enough to replace the fabric net 122 on the delivery cylinder 42 with the coating blanket 124 packed to the required extent necessary for providing the proper pressure to effect coating of the sheet thickness to be printed. Thereafter, the pumps 110 and 112 are activated and the press 12 re-started. The extensible cylinder 74 can then be activated to control the pressure of the pick-up roller 68 against the delivery cylinder 42 to obtain the desired application of coating material to the freshly printed sheets 18.

Notably, with the coating apparatus 10 of the present invention, no timing adjustments between the delivery cylinder 42 and the impression cylinder 36 are required to achieve and maintain precise registration between application of the coating material and the printed surface of the sheets 18. Further, the coating unit 60 permits a wide range of coating weights to be applied to the printed sheets 18 by quickly and easily changing pick-up rollers 68 from those designed to produce a very light coating application to those designed to produce a very thick coating application can be used.

From the foregoing, it should be apparent that the coating apparatus 10 of the present invention provides a highly reliable, effective and economical in-line apparatus for selectively applying coating material to the freshly printed sheets 18 in a sheet-fed, offset rotary printing press 12 which allows the final printing station to continue to be used as a print station, yet which does not require any substantial press modification or the addition of a separate timed applicator roller. While a particular form of the present invention has been illustrated and described, it should be apparent that varia-

tions and modifications therein can be made without departing from the spirit and scope of the invention.

We claim:

1. In a sheet-fed, offset rotary printing press of the type including at least one printing station having a blanket cylinder and an impression cylinder disposed for printing ink onto sheets passing therebetween, and a delivery conveyor system for pulling freshly printed sheets from the impression cylinder and transporting the printed sheets toward a sheet delivery stacker, the delivery conveyor system including a delivery drive shaft disposed adjacent to and extending parallel with the impression cylinder and driven in timed synchronous relation with the impression cylinder, the improvement comprising:

a delivery cylinder mounted to said delivery drive shaft and having an outer peripheral support surface adapted to engage and support a sheet being transported by said delivery conveyor system;

a coating apparatus including a supply of liquid coating material, a rotatable pick-up roller having an outer peripheral surface of substantially cylindrical shape, and means for applying a coating of liquid coating material from said supply onto said outer peripheral surface of said pick-up roller; and

means for mounting said coating apparatus to the press adjacent said delivery cylinder including selectively operable means for moving said pick-up roller between a first operable position with a portion of said peripheral surface of said pick-up roller engaged with said support surface of said delivery cylinder, and a second inoperable position with said peripheral surface out of engagement with said support surface of said delivery cylinder, whereby when said pick-up roller is in said first operable position, liquid coating material from said supply applied onto said peripheral surface of said pick-up roller is transferred to said support surface of said delivery cylinder and to said freshly printed sheet.

2. The improvement as set forth in claim 1 wherein said delivery cylinder includes a coating blanket disposed over said peripheral support surface.

3. The improvement as set forth in claim 1 wherein said delivery cylinder includes a removable coating blanket disposed over said peripheral support surface when said pick-up roller is in said first operable position.

4. The improvement as set forth in claim 3 wherein said coating blanket has a rubber outer surface.

5. The improvement as set forth in claim 3 wherein said delivery cylinder includes a fabric net disposed over said peripheral support surface when said pick-up roller is in said second inoperable position.

6. The improvement as set forth in claim 1 wherein said coating apparatus includes an elongated reservoir containing said supply of liquid coating material, said reservoir being disposed to extend parallel with said pick-up roller with a portion of said peripheral surface extending into said reservoir in contact with liquid coating material contained therein, and at least one doctor blade attached to said reservoir and engaging said peripheral surface, said doctor blade acting to limit the amount of liquid coating material applied onto said peripheral surface from said reservoir.

7. The improvement as set forth in claim 6 wherein said reservoir and said pick-up roller are movably coupled to said press and said selectively operable means includes an extensible cylinder coupled between said reservoir and said press and operable to move said reservoir and said pick-up roller between said first and second positions.

8. The improvement as set forth in claim 7 wherein said pick-up roller is rotatably driven by a motor attached to said coating apparatus.

9. The improvement as set forth in claim 8 wherein said delivery cylinder includes a rubber coating blanket disposed over said peripheral support surface when said pick-up roller is in said first operable position, and includes a fabric net disposed over said peripheral support surface when said pick-up roller is in said second inoperable position.

10. The improvement as set forth in claim 9 wherein said coating apparatus is mounted to said press downstream of said delivery drive shaft in the direction of travel of said sheets during transport by said delivery conveyor system.

11. The improvement as set forth in claim 1 wherein said mounting means includes first and second side frames mounted on said press, a support shaft mounted on and extending between said first and second side frames, a support bracket attached to said coating apparatus and movably coupled to said support shaft for pivotal movement between said first and second positions, and said selectively operable means includes an extensible cylinder coupled between said coating apparatus and said support bracket and operable to move said coating apparatus toward and away from said delivery cylinder.

12. In a sheet-fed, offset rotary printing press of the type including at least one printing station having a blanket cylinder and an impression cylinder disposed for printing wet ink onto sheets passing therebetween, and a delivery conveyor system for pulling freshly printed sheets from the impression cylinder and transporting the printed sheets toward a sheet delivery stacker, the delivery conveyor system comprising a pair of endless gripper chains disposed on opposite sides of the press and supporting therebetween gripper bars and grippers spaced along the chains, the gripper chains being driven in timed synchronous relation with the impression cylinder by laterally spaced sprocket wheels mounted on opposite ends of a delivery drive shaft disposed adjacent to and extending parallel with the impression cylinder, the improvement comprising:

a delivery cylinder mounted to said delivery drive shaft between said sprocket wheels and having an outer peripheral support surface covered by a removable coating blanket adapted to engage and support the wet ink side of a sheet being transported by said gripper bars;

a coating apparatus including a supply of liquid coating material, a rotatable pick-up roller having an outer peripheral surface of substantially cylindrical shape communicating with said supply, and means for applying liquid coating material from said supply onto said peripheral surface of said pick-up roller; and,

means for mounting said coating apparatus to the press adjacent the delivery cylinder, said means including selectively operable means for moving said coating apparatus between a first operable position with a portion of said peripheral surface of said pick-up roller engaged with said delivery cylinder, and a second inoperable position with said peripheral surface of said pick-up roller out of engagement with said delivery cylinder, whereby when said coating apparatus is in said first operable

position, liquid coating material from said supply metered onto said peripheral surface of said pick-up roller is transferred to said delivery cylinder and to said freshly printed sheet, and when said coating apparatus is in said second inoperable position, said delivery cylinder is disposed for non-coating sheet delivery operation.

13. The improvement as set forth in claim 12 wherein the effective diameter of said delivery cylinder covered by said coating blanket is sufficient to apply pressure to sheets against said impression cylinder as said sheets are pulled from said impression cylinder by said gripper bars.

14. The improvement as set forth in claim 13 wherein said coating blanket has a rubber outer support surface.

15. The improvement as set forth in claim 14 wherein said coating apparatus is disposed downstream of said delivery drive shaft in the direction of travel of said sheets during transport by said delivery conveyor system.

16. A sheet-fed, offset rotary printing press including:

at least one printing station having a blanket cylinder and an impression cylinder disposed for printing wet ink onto sheets passing therebetween;

a delivery conveyor system for pulling freshly printed sheets from the impression cylinder and transporting the printed sheets toward a sheet delivery stacker, the delivery system including a delivery drive shaft;

a delivery cylinder mounted to said delivery drive shaft and having an outer peripheral support surface adapted to engage and support a sheet being transported by said delivery conveyor system;

a coating apparatus including a supply of liquid coating material, a rotatable pick-up roller having an outer peripheral surface of substantially cylindrical shape communicating with said supply, and means for applying liquid coating material from said supply onto said peripheral surface of said pick-up roller; and

means for mounting said coating apparatus to the press adjacent said delivery cylinder, said means including selectively operable means for moving said pick-up roller between a first operable position with a portion of said peripheral surface of said pick-up roller engaged with said delivery cylinder, and a second inoperable position with said peripheral surface of said pick-up roller out of engagement with said delivery cylinder, whereby when said pick-up roller is in said first operable position, liquid coating material from said supply applied to said peripheral surface of said pick-up roller is transferred to said delivery cylinder and then to said freshly printed sheet.

17. A sheet-fed, offset rotary printing press as set forth in claim 16 wherein said delivery cylinder includes a removable coating blanket disposed over said peripheral support surface when said pick-up roller is in said first operable position.

18. A sheet-fed, offset rotary printing press as set forth in claim 17 wherein said coating blanket has a rubber outer surface.

19. A sheet-fed, offset rotary printing press as set forth in claim 17 wherein said delivery cylinder includes a fabric net disposed over said peripheral support surface when said pick-up roller is in said second inoperable position.

20. A sheet-fed, offset rotary printing press as set forth in claim 19 wherein said coating apparatus includes an elongated reservoir containing said supply of liquid coating material, said reservoir being disposed to extend parallel with said pick-up roller with a portion of said peripheral surface extending into said reservoir in contact with liquid coating material contained therein, and at least one doctor blade attached to said reservoir and engaging said peripheral surface, said doctor blade acting to limit the amount of liquid coating material applied onto said peripheral surface from said reservoir.

21. A sheet-fed, offset rotary printing press as set forth in claim 20 wherein said selectively operable means includes an extensible cylinder coupled between said reservoir and said press and operable to move said reservoir and said pick-up roller laterally between said first and second positions.

22. A sheet-fed, offset rotary printing press as set forth in claim 21 wherein said pick-up roller is rotatably driven by a motor attached to said coating apparatus.

* * * * *

67

US005178678A

United States Patent [19]

Koehler et al.

[11] **Patent Number: 5,178,678**

[45] **Date of Patent: Jan. 12, 1993**

[54] **RETRACTABLE COATER ASSEMBLY INCLUDING A COATING BLANKET CYLINDER**

[75] Inventors: **Jamie E. Koehler**, Montreal, Canada; **James E. Taylor**, Dallas, Tex.; **Mark A. DiRico**, Quincy, Mass.

[73] Assignee: **Dahlgren International, Inc.**, Carrollton, Tex.

[21] Appl. No.: **544,996**

[22] Filed: **Jun. 27, 1990**

Related U.S. Application Data

[63] Continuation-in-part of PCT/US90/03338, filed Jun. 13, 1990, which is a continuation-in-part of Ser. No. 365,680, Jun. 13, 1989, Pat. No. 4,934,305.

[51] **Int. Cl.**[5] **B05C 1/08**; B05C 1/02

[52] **U.S. Cl.** **118/46**; 101/177; 101/178; 118/211; 118/224; 118/262; 427/407.1; 427/558

[58] **Field of Search** 101/177, 178, 147, 146; 118/46, 211, 262, 224, 249; 427/54.1, 407.1

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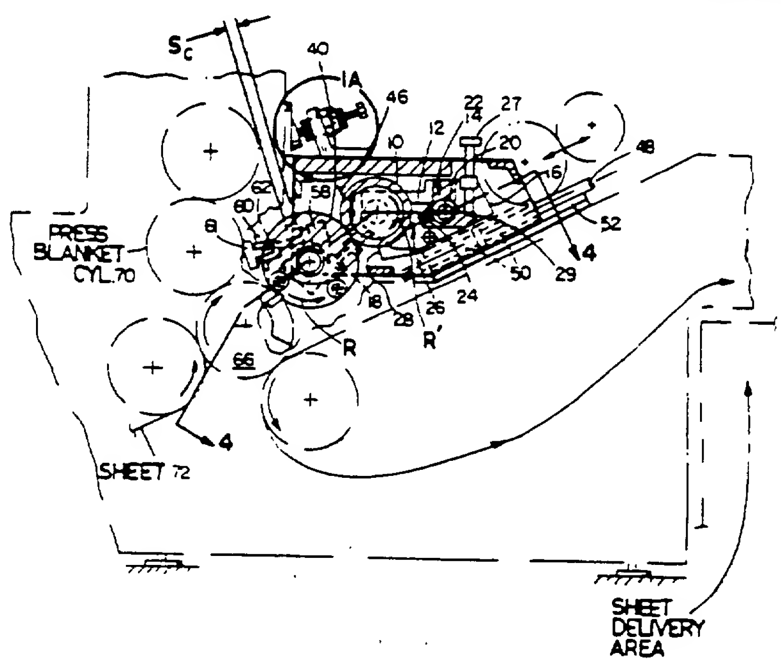
Primary Examiner—Willard Hoag

[57] **ABSTRACT**

An addition to a multi-color lithographic offset printing press comprising a self-contained coating unit moveable into and out of operative relationship with an impression cylinder on the press unit (e.g. the impression cylinder of the last press unit) without interrupting or disrupting printing taking place in this last stage. The coating unit includes a special blanket cylinder, a transfer cylinder and doctor or metering means to control the amount of coating material on the transfer cylinder. Inclined tracks are provided to guide the coating unit into and out of operative relationship with the impression cylinder of the last printing stage.

49 Claims, 10 Drawing Sheets



W019629

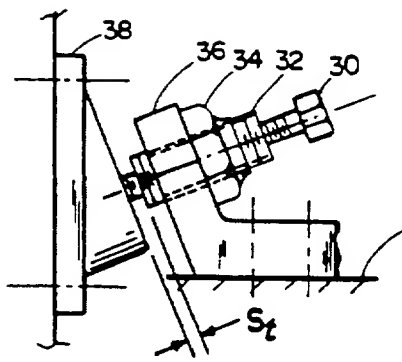

38
36
34
32
30
46
S_t

FIG. 1A

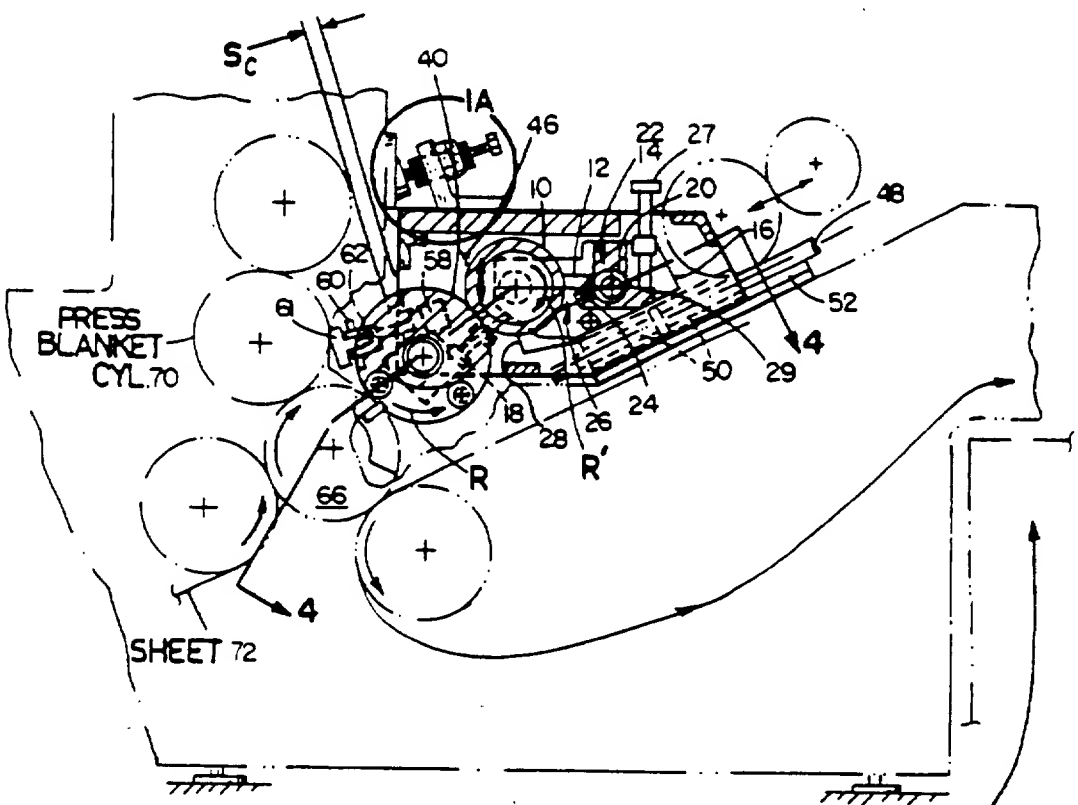
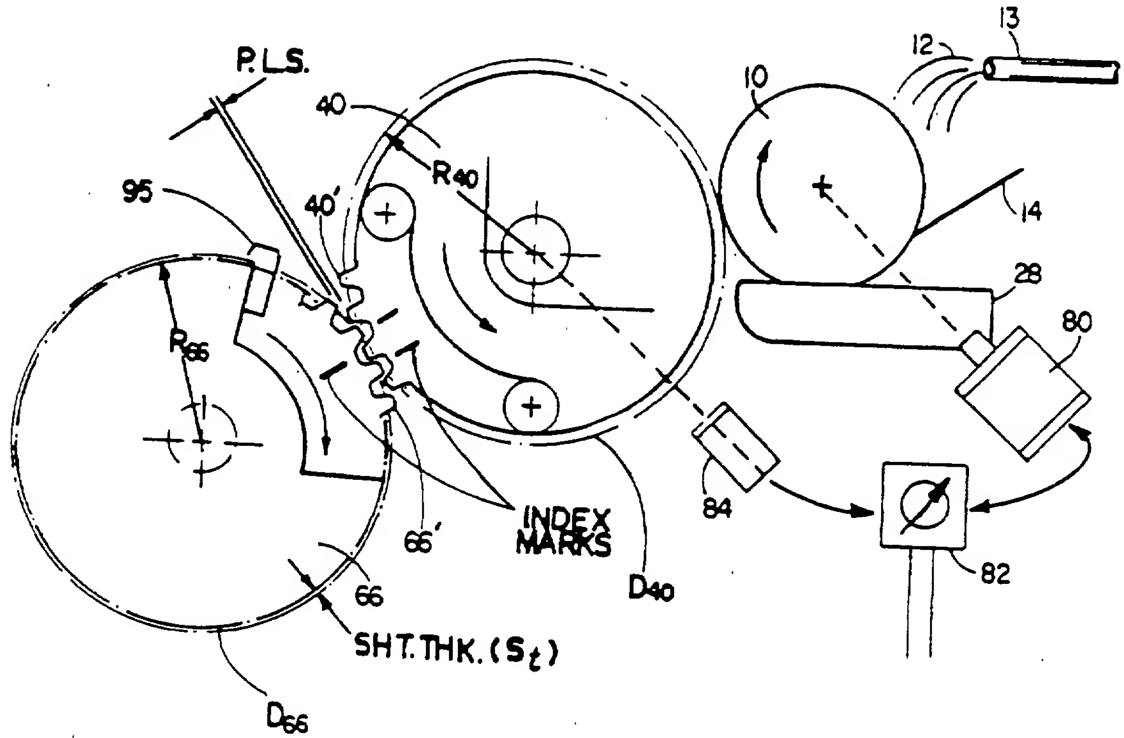

S_c
40
1A
46
22
27
14
12
10
20
16
48
62
58
60
61
PRESS BLANKET CYL. 70
52
4
50
29
24
18
26
28
R
R'
66
4
SHEET 72
SHEET DELIVERY AREA

FIG. 1


P.L.S.
40
95
40'
R40
13
12
10
14
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80
R66
84
82
INDEX
MARKS
66'
66
D40
SHT.THK. (St)
D66

FIG. 2

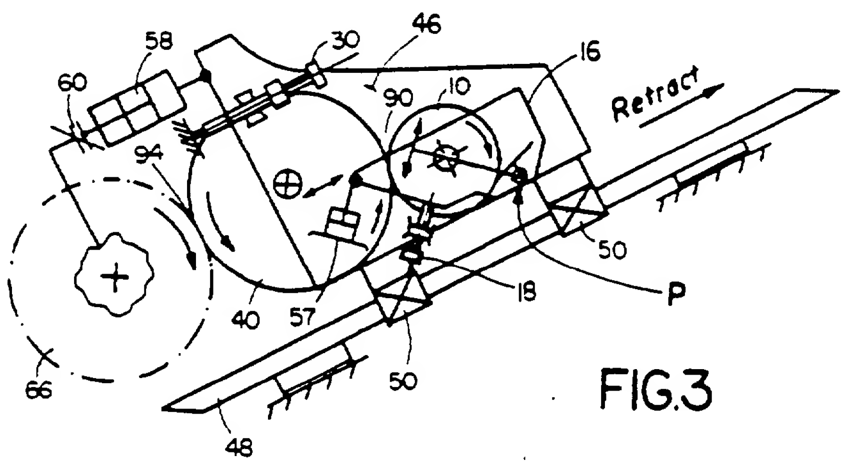

58
30
46
16
60
90
10
Retract
94
50
P
18
40
57
66
50
48

FIG.3

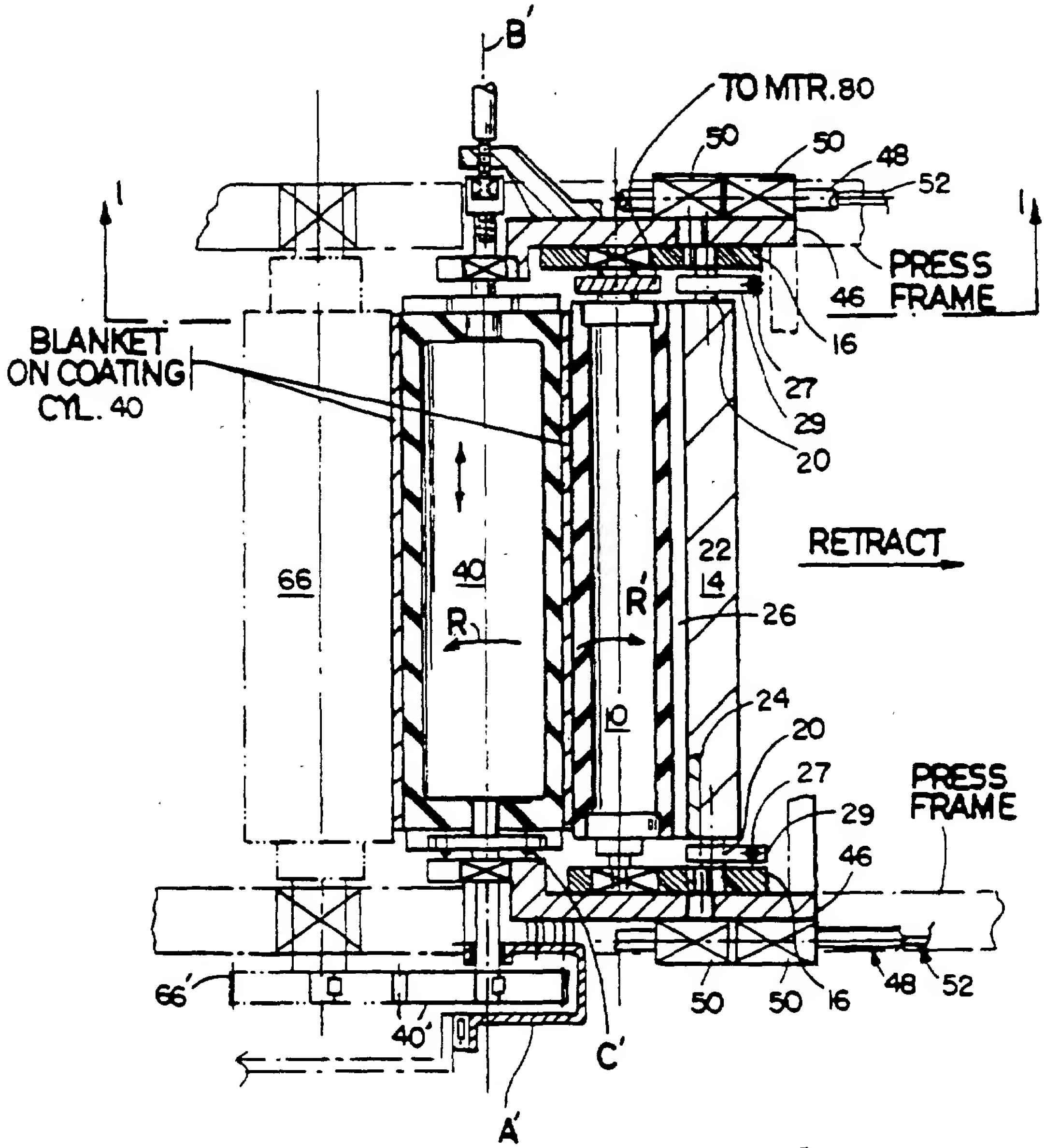
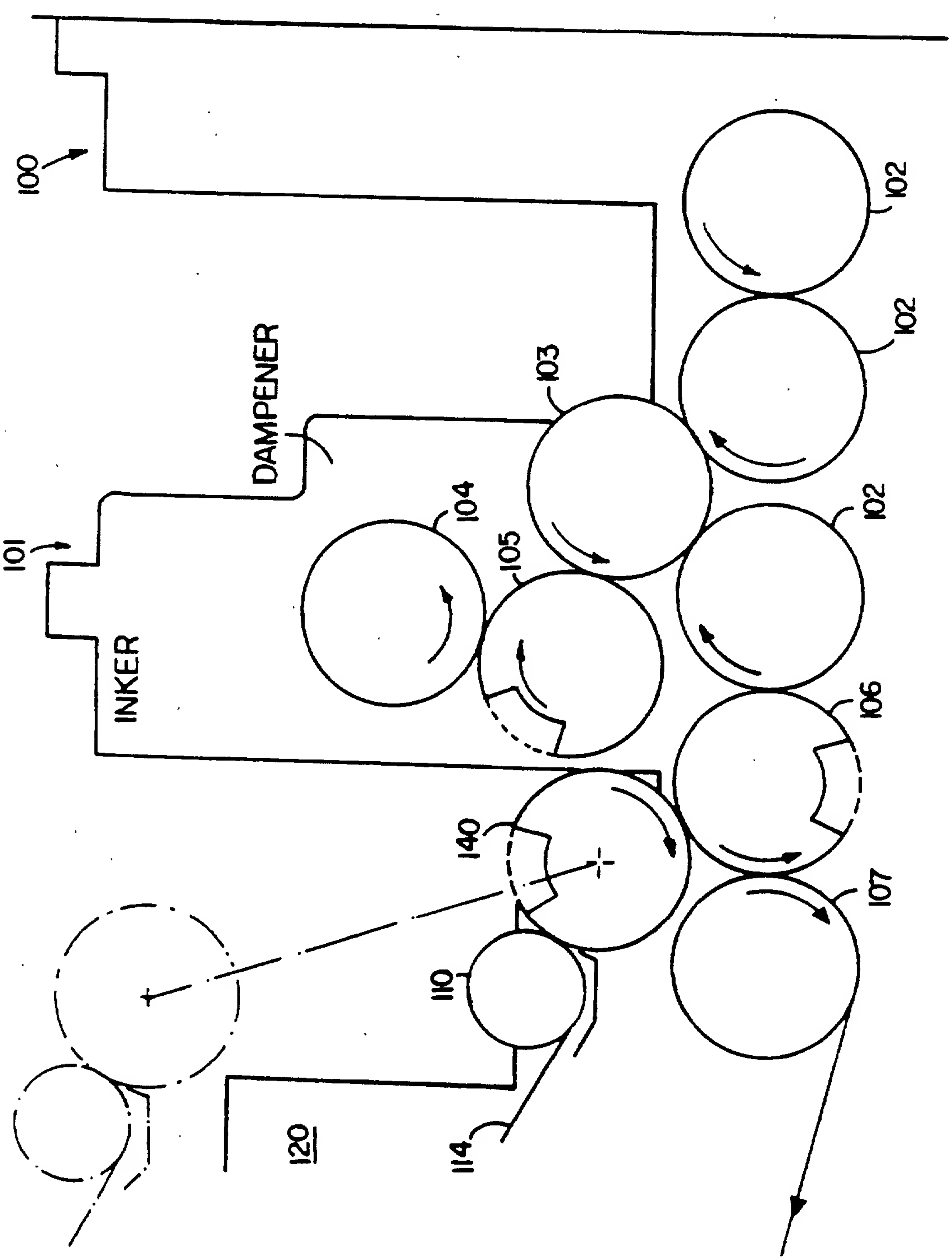


FIG.4

W019632

FIG.5


100
101
102
102
102
103
104
105
106
107
110
114
120
140
DAMPENER
INKER

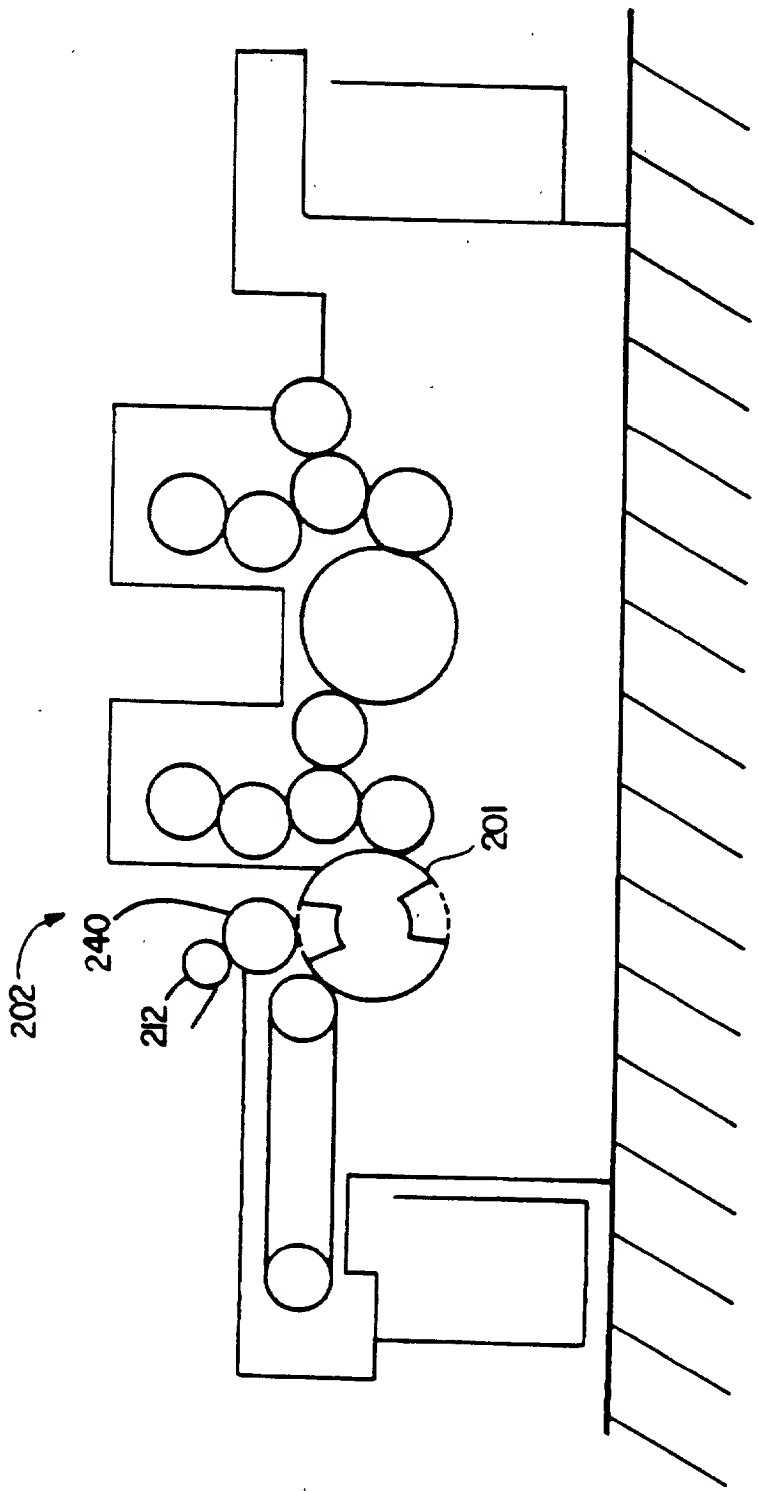


FIG.6

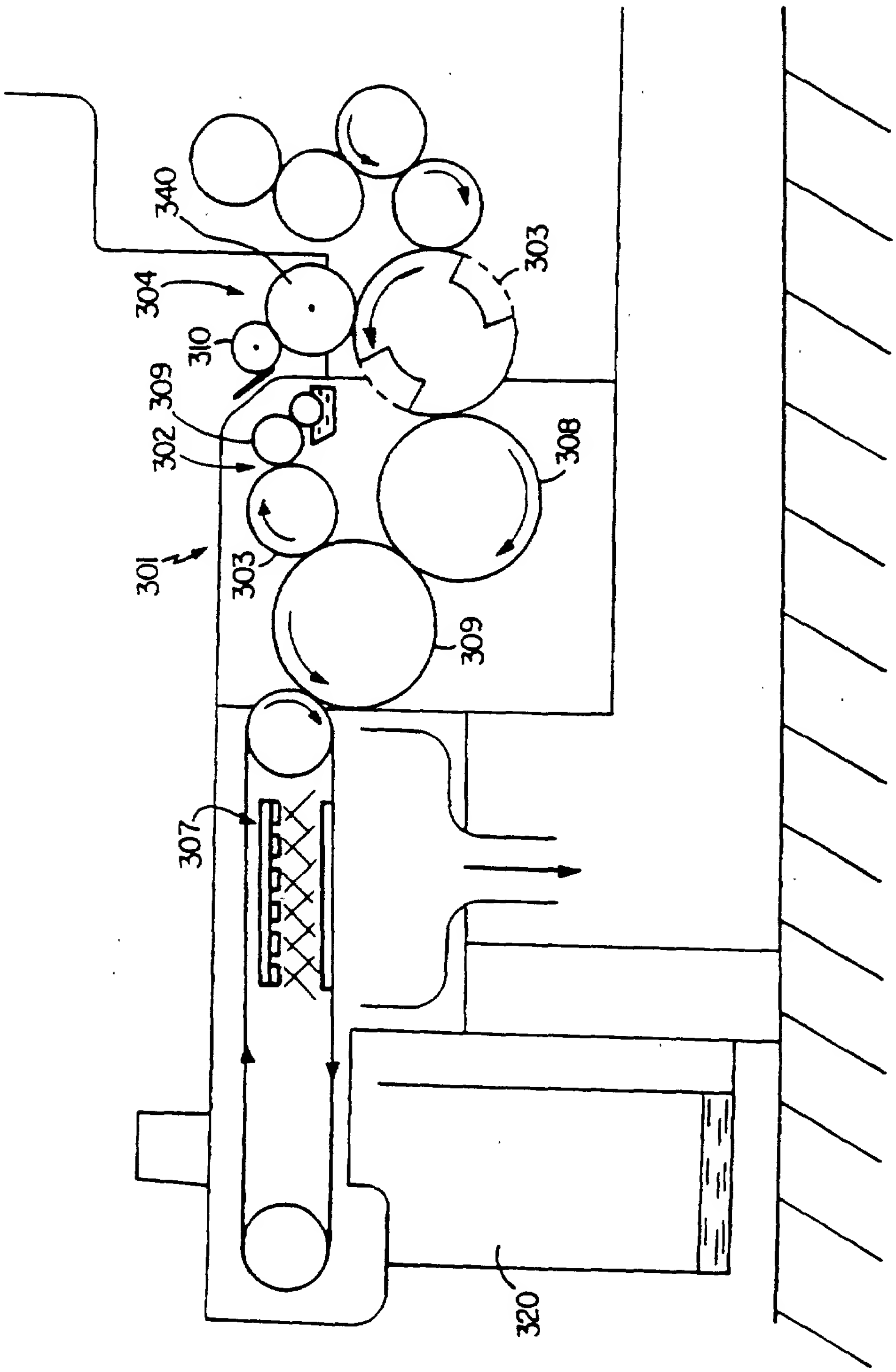


FIG. 7

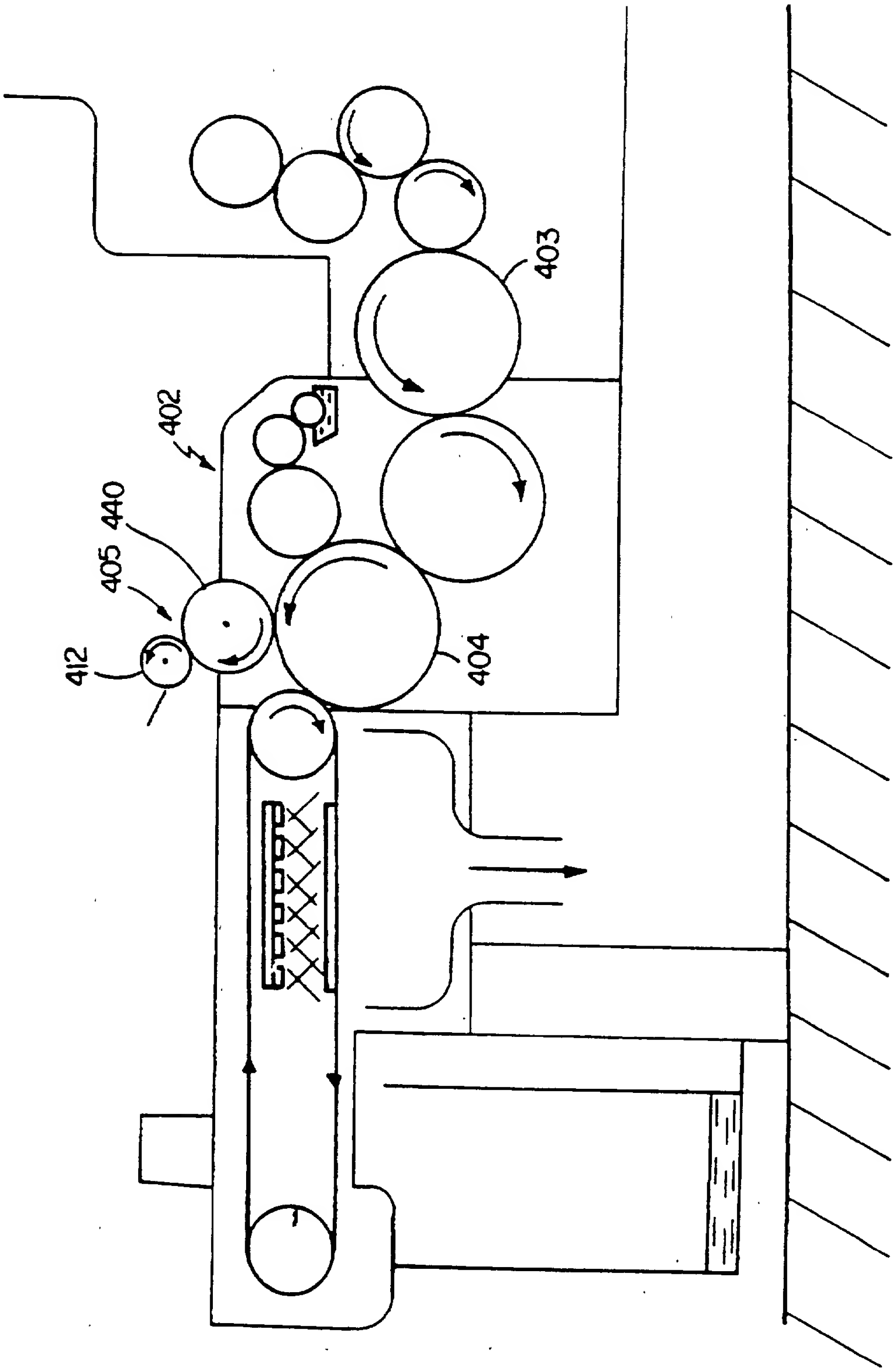


FIG.8

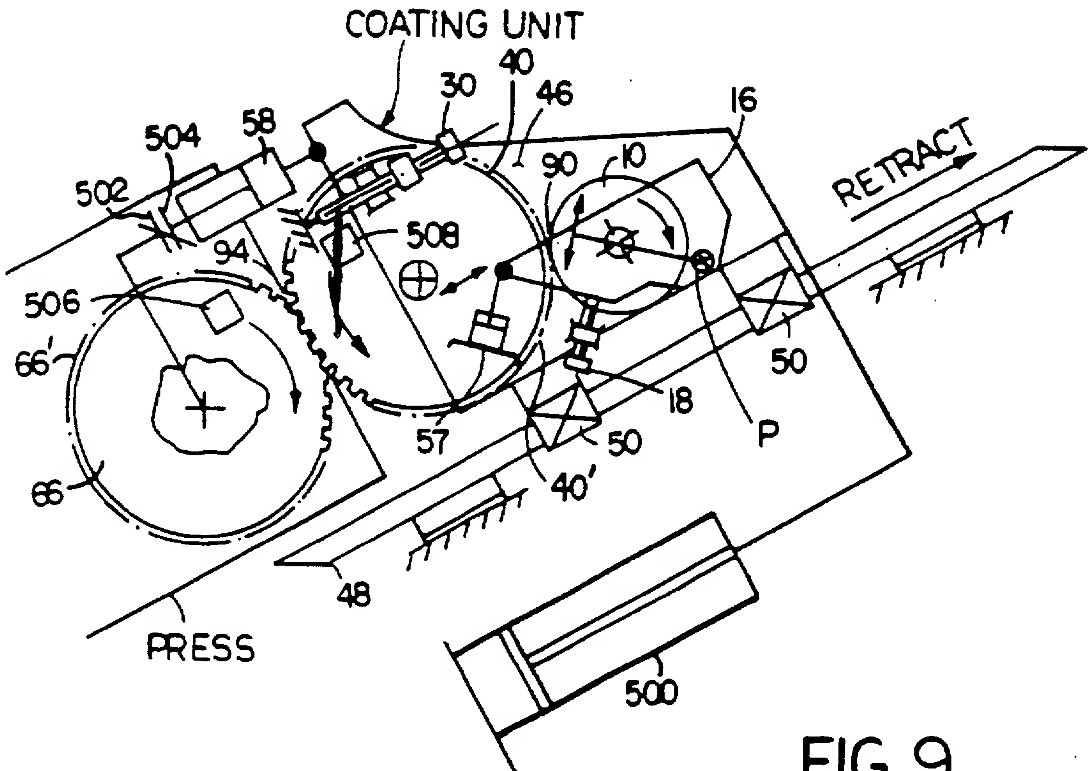

COATING UNIT
30
40
46
16
504
58
502
90
10
RETRACT
508
94
506
66'
50
18
66
57
50
P
40'
48
PRESS
500

FIG. 9

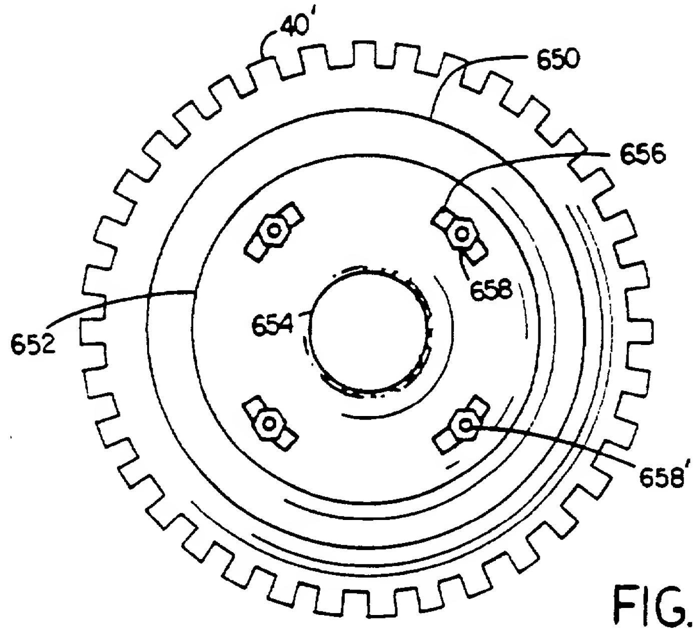
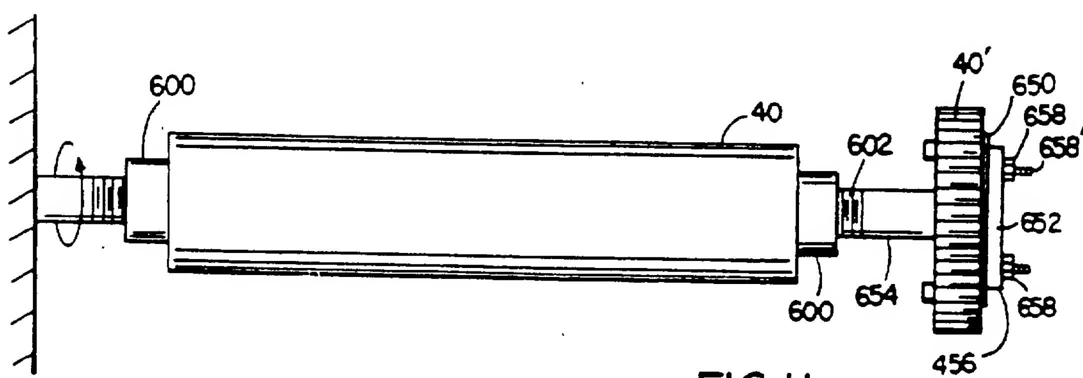

40'
650
656
658
654
652
658'

FIG. 10


600
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40'
650
658
658'
602
652
654
600
658
456

FIG. 11

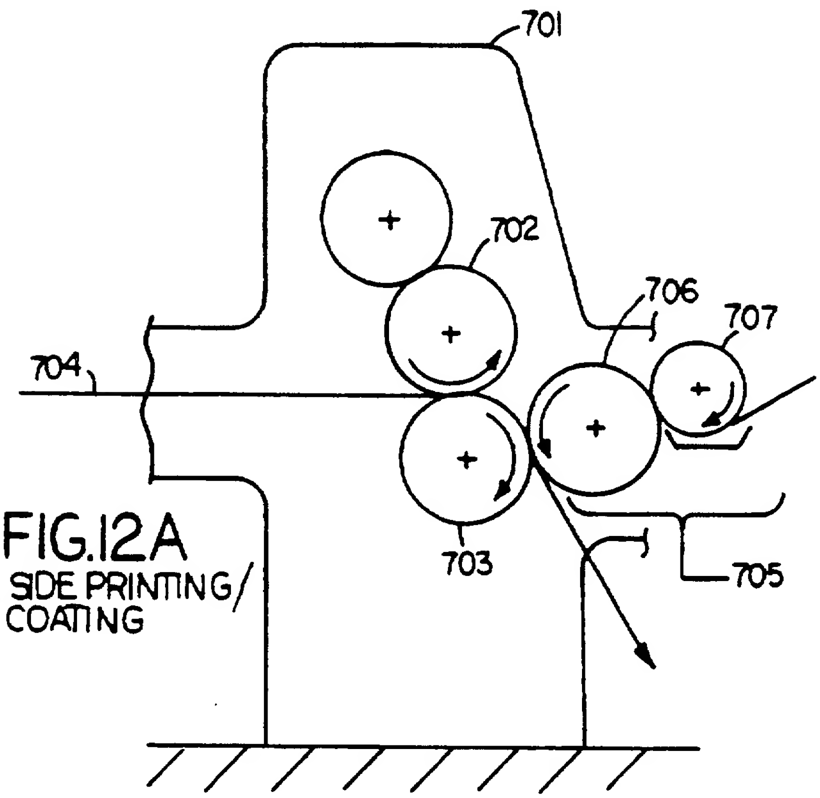

FIG.12A
ONE SIDE PRINTING/
TOP COATING

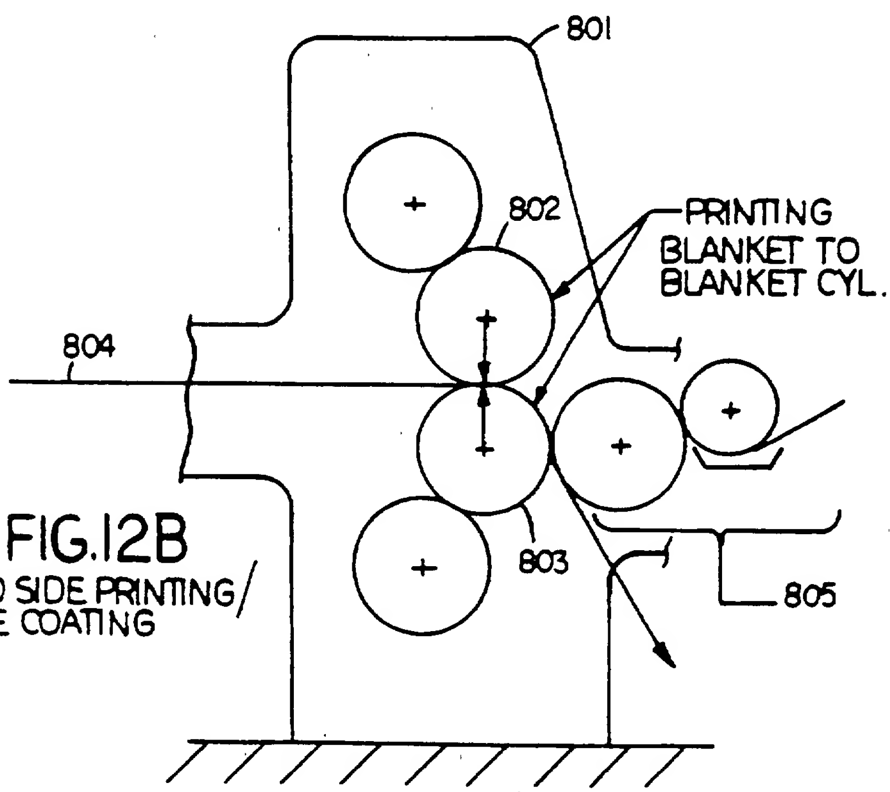

FIG.12B
TWO SIDE PRINTING/
SIDE COATING

RETRACTABLE COATER ASSEMBLY INCLUDING A COATING BLANKET CYLINDER

BACKGROUND OF THE INVENTION

This application is a continuation-in-part of PCT/US 90/03338 filed Jun. 13, 1990, which in turn was a continuation-in-part of U.S. Ser. No. 365,680, filed Jun. 13, 1989 and now U.S. Pat. No. 4,934,305.

This invention relates to coating printed workpieces, e.g. sheets. It more particularly refers to a process and apparatus for coating workpieces which have been printed on offset printing equipment.

In many applications it is desirable to apply a spot or overall coating to a printed workpiece. For example, a UV curable or water-soluble polymer finish may be applied to a workpiece printed by offset lithography. The coating is quickly dried while the surface of the ink is still tacky. This coating avoids the need for powder driers sprayed between sheets to present offsetting of oxidation-dried inks that are slow to dry. These coatings are also useful for providing a glossy finish that improves the rub-resistance of the workpiece and improves its overall appearance and feel. Finally, adhesive coatings may be applied to printed packaging; for example, heat-set adhesives may be applied to enable attachment of a feature such as clear plastic bubble of a package used to display the product. It is said that ultraviolet-cured and aqueous overprint coatings are, by some measurements, the fastest growing segments of the printing industry.

Application of coatings to a workpiece is made difficult by various requirements. For example, the coating should be uniform and its thickness should be controlled. Moreover, the aqueous coating should be applied quickly, before its vehicle evaporates causing it to thicken. Finally, it is desirable for the coater to operate "in-line" with the press that prints the workpiece to take full advantage of the fast-drying capability of coatings and generally to simplify the manufacture of printed coated workpieces.

Butler U.S. Pat. No. 4,270,483 discloses an in-line coating apparatus for attachment to a conventional offset lithographic printing press. The apparatus includes a set of rollers (i.e., pick-up roller **14** and application roller **16**) to deliver coating material from a reservoir **18** to a standard press unit blanket roll **108**. A metering rod **40** meters the amount of coating transferred to application roller **16**.

An in-line coater sold by Norton Burdett Co. of Nashua, N.H. has a single roller driven directly by a D.C. motor. The roller is a gravure cylinder that transfers coating to a standard press unit blanket cylinder. The coater is attached to a pivoting arm, and the unit can be pivoted away from the press unit when the coater is not in use.

Another in-line coater, sold by IVT Colordry, Inc. of Fairfield, Conn., applies coating from a reservoir pan to a standard press unit blanket cylinder using a pick-up roller that delivers a coating supply to an applicator roller; the applicator roller applies the coating to the blanket cylinder of a press unit.

Kumpf U.S. Pat. No. 3,768,438 discloses a coater in which a fountain roller dips into a coating reservoir and transfers liquid coating material to a feed roller. The feed roller in turn transfers coating material to a coating roller that coats a sheet fed between the coating roller and a format roller.

DiRico U.S. Pat. No. 4,685,414 discloses a process and apparatus for use in combination with an existing press unit wherein the coating means is retractable, to be used or not as the printer requires. In this device, the coating means utilizes the blanket roll of the last unit of the press, and this last unit cannot be used for color application means when it is used for coating. For example in a four color press, utilizing the coating apparatus of the '414 patent would then permit only three colors to be printed in in-line, single pass operation.

Bird U.S. Pat. No. 4,796,556 discloses an offset lithographic apparatus with a plate cylinder and a blanket cylinder, and an in-line coater to apply liquid coatings either in a pattern or over the entire workpiece. The apparatus has a carriage which moves the coater between a first position operative association with the plate cylinder of the lithographic press unit (see full line of unit **72** in FIG. **1**) and a second position in operative association with the blanket cylinder of the lithographic press unit (see broken line of unit **72** in FIG. **1**). In the first position the coater applies spot coating, and in the second position the coater applies coating over the entire sheet.

Satterwhite U.S. Pat. No. 4,308,796 discloses apparatus for adapting an offset lithographic press to flexographic operations, the flexographic operation being either for coating or printing. Coating is achieved by applying a photosensitive plate to the lithographic blanket roll of the offset press. A transfer roll supplies coating to the plate. Inking is achieved in a like manner but with a flexographic plate having raised image areas.

Makosch U.S. Pat. No. 4,397,237 discloses a pivoting secondary inking system ("B" in FIG. 2).

Preuss et al. U.S. Pat. No. 3,391,791 discloses a sheet coater which moves into engagement with various cylinders in a press delivery area.

Knodel et al. U.S. Pat. No. 3,916,824 discloses a coating assembly which includes a fountain roll, a metering roll and an applicator roll for coating band of ribbon material. The coater is horizontally displaceable on an auxiliary frame.

Jahn U.S. Pat. No. 4,615,293 and 4,706,601 disclose separate duplex coating units disposed downstream of a printing press. The units permit coating of selected portions of the workpiece using a relief plate or permit blanket coating.

Switall U.S. Pat. No. 4,617,865 discloses a coater that can be pivoted into and out of position in contact with the blanket cylinder of the press unit; the coater being retractable with the same limits as that of the Di Rico device, i.e., the coating and printing functions cannot be performed simultaneously.

Jirousek U.S. Pat. No. 2,320,523 discloses a self-adjusting dampening roll.

Edwards U.S. Pat. No. 4,222,325 discloses a retractable dampening and inking unit.

Egnaczak U.S. Pat. No. 3,800,743 discloses a coater for a photoelectrophoretic process.

DeLigt U.S. Pat. No. 3,397,675 discloses a coating or printing station having its applicator and transfer rolls attached to pivotally mounted supporting frames.

Some commercial presses, such as Heidelberg GTO and MO include an extra blanket cylinder e.g., for numbering, printing extra colors, perforating, center slitting, etc. This added cylinder is a fixed part of the press, and

does not retract with associated equipment for numbering or imprinting.

SUMMARY OF THE INVENTION

This invention generally features a coating apparatus that operates on line with an impression cylinder of a lithographic printing press to apply a liquid coating to a workpiece. The invention is particularly (but not exclusively) adapted to sheet-fed lithographic presses. The coating apparatus of the invention has an integrated, independent, cooperatively operating, coating assembly whose components include a liquid coating supply means, a special coating blanket cylinder (in addition to any blanket cylinder(s) that are already part of the press), and means for metering and transferring coating material operatively connected to the coating blanket cylinder and to the liquid coating supply means, for controlling the amount of coating supplied onto the coating blanket cylinder from the supply means. Structural members integrate the means for metering and transferring coating and the coating blanket cylinder into the coating assembly so that the coating assembly components remain fixed relative to one another as the assembly moves relative to the impression cylinder of the press. The apparatus also includes a means for positively driving the coating blanket cylinder in association with the press unit impression cylinder and mounts for guiding movement of the coating assembly between an operative position, in which the coating blanket cylinder is operatively engaged with the press unit impression cylinder, and an off-imprint (or off-impression) position, in which the coating blanket cylinder and drive is slightly separated from the impression cylinder (i.e., separated sufficiently to prevent contact). In the operative position the coating blanket cylinder can be accurately adjusted relative to the impression cylinder. Moreover, the coating assembly can be actuated so the coating blanket cylinder is slightly separated from the impression cylinder Such adjustment and actuation are achieved without a change in the coating blanket cylinder position relative to the coating metering and transfer means.

One embodiment of the system is especially adaptable to press types such as the Heidelberg Speedmaster TM line of presses, where there is access between the press blanket cylinder of the last press unit and the sheet transfer cylinder of the delivery to add a blanket cylinder for coating on the impression cylinder of the press unit In this embodiment, the press impression cylinder which engages the coating assembly is also operatively associated with the printing blanket cylinder on the press. In operation, a sheet on the impression cylinder contacts the printing blanket at a first location on the sheet while it contacts the coating assembly blanket at a second location on the sheet, enabling simultaneous printing and coating at a single impression cylinder.

Alternatively, in other embodiments for presses that cannot accommodate the coating assembly at the press impression cylinder, it is possible to replace (retrofit) a press transfer cylinder with an impression cylinder that can accommodate the coating blanket cylinder of the coating assembly. For example, where the printing press comprises an accessible transfer cylinder, an impression cylinder may be retrofit into a position ordinarily occupied by the transfer cylinder One version of this embodiment features using the coating assembly at an impression cylinder that has been retrofit in place of a transfer cylinder upstream from a tower coater In this embodiment, the sheet workpiece is precoated prior to coating at the tower coater

Yet another preferred embodiment of the invention features retrofitting a fixed coating tower with the coating assembly of the invention. The fixed coater has an impression cylinder operatively connected to a fixed coating blanket cylinder. The coating assembly is retrofit to the fixed coating impression cylinder so that the coating assembly blanket cylinder of the invention and the fixed coating blanket cylinder both operate simultaneously on the fixed coating impression cylinder In this way, two layers of coating are applied simultaneously to the same workpiece.

The coating blanket cylinder of the coating assembly is adapted to provide a coating surface, which preferably is the generally same basic diameter as the standard printing blanket cylinder. By "adapted to provide a coating surface", we mean that the coating blanket cylinder can receive a standard resilient blanket, or it can receive a relatively hard or resilient relief plate or its equivalent. Alternatively, the cylinder could have a surface with permanent relief. For spot-coating, the coating blanket cylinder carries a photopolymer relief plate or equivalent. This cylinder is also preferably equipped for circumferential and lateral (side) register to enable accurate positioning of the plate. Pin register may also be supplied for pre-positioning of the plate relative to the positions of upstream printing plates. Pin-register may be supplied in lieu of, or, in conjunction with circumferential and side register means The photopolymer plate may be installed in the same blanket reels or clamps as provided for the blanket, or, may be attached to the cylinder, independent of the blanket clamping provisions. The coating blanket cylinder continuously delivers a smooth, uniform metered amount of liquid coating material to the workpiece carried on the press unit impression cylinder.

Preferred embodiments of the invention are characterized as follows. The mounts guide the coating assembly to move to a fully retracted position in which the assembly and particularly the coating blanket cylinder are completely disengaged from the press unit impression cylinder at a remote location from the press unit cylinders. The coating transfer means comprises a transfer (delivery) cylinder (e.g. an engraved or smooth cylinder) in operative contact with the coating blanket cylinder, as well as a metering means (an elongated blade or a metering roll) for metering the amount of coating carried on the transfer cylinder. The coating assembly is mounted on an inclined support attached to the press frames of the delivery section of the press. Means are provided for moving the coating apparatus toward or away from the press unit. Specifically, these means can include a hydraulic cylinder. Coating is circulated by recirculation means. Coating is supplied between the transfer means and the metering means, flows longitudinally along the length of the transfer and metering means and cascades at the ends thereof to a drip pan positioned below the metering means. A drip pan outlet is in operative association with the recirculation means, and the coating supply means communicates with the recirculation means, to supply recirculated coating to the transfer and metering means The coating blanket mounted on the blanket cylinder and the press unit blanket cylinder have substantially the same effective operating diameter The apparatus includes means to control pressure or width of the nip between the transfer cylinder and the coating blanket

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cylinder. The apparatus also includes means to control the actuation, adjustment and speed of the transfer cylinder relative to the blanket cylinder. A gear is adapted to positively, drivingly, couple the coating blanket cylinder to the impression cylinder when the assembly is in the first (operating) position. This gear can be made of a special plastic material Additionally, the impression cylinder includes a gear adapted to drive the gear on the coating blanket cylinder. Means are provided for registering the coating blanket cylinder gear with the adjacent impression cylinder gear. Proximity sensors located on the coating blanket cylinder gear and the impression cylinder gear are utilized to rotationally align these gears with one another. The press will not start unless the gears are sensed to be in the proper position relative to each other. The apparatus also includes means for adjusting the coating blanket cylinder relative to the press unit impression cylinder while the two cylinders remain drivingly engaged. An adjustable stop controls the nip between the coating blanket cylinder and the impression cylinder, without changing the relationship between the coating blanket cylinder and the liquid coating metering and transfer means. Specifically, this stop can be a threaded screw. The coating blanket cylinder is preferably lightweight (aluminum) with means enabling lateral and/or circumferential register adjustment relative to the adjacent press impression cylinder Circumferential register adjustment means includes a plurality of bolts and nuts, as well as correspondingly positioned slots in a plate secured to the coating blanket cylinder, which are adapted to allow for rotational movement of the coating blanket cylinder with respect to the coating blanket cylinder gear. Lateral register adjustment means includes threaded collars adapted to allow for lateral movement of the coating blanket cylinder, located at both ends of said coating blanket cylinder. There is provided a means of locking the coating apparatus to the press unit. Specifically, the means can include a cylinder clevis and a press-mounted lug, cooperatively sized and positioned to engage said clevis, and a releasable latch pin adapted to connect the clevis to the lug Alternatively, the means can include a pair of cooperatively sized and positioned electromagnets which, when de-energized, allow the coating assembly to be released for movement to a location remote from the press unit.

This invention thus provides a direct coating system for a sheet fed printing press, preferably a multi-color press, and enables in-line printing and coating at the same time on a single press unit, thus maintaining the printing capability of the printing press unit. When a press unit (preferably the final press unit) is retrofitted with the retractable coating assembly of this invention, an existing impression cylinder in the press unit may act as a common impression cylinder, so that ink is first applied to a sheet being fed on the impression cylinder and a coating is applied directly to the sheet over the last ink application. After this dual sequential application of ink and coating onto a sheet on the same impression cylinder, the coating can be suitably dried by air, infra-red heat, ultra-violet radiation or any other means adapted to quickly dry the coating.

This apparatus is capable of delivering a metered amount of coating through a special blanket roll to a sheet carried by the last impression cylinder in a printing press substantially without interrupting or changing the printing process. It allows spot coating or overall coating as may be desired by the printer It operates without the use of bulky complex metering systems, yet the apparatus is versatile in that the printer can bring the coater in line or not, as he desires, without changing or interfering with an existing printing operation. Adjustment of the coating blanket cylinder and entire assembly is made relative to the impression cylinder to compensate for various sheet thicknesses to be printed. The assembly is furthermore actuatable while still drivingly engageable with the impression cylinder, to on-off positioning of the cylinder when operating in the first position.

The entire apparatus is further retractable to the second position by a simple retraction device, such as a linear-actuator, winch, hydraulic cylinder or the like, up an inclined plane (the same plane as for movement for adjustment and actuation), to provide access to, (1) the coating blanket cylinder for changing blankets, packing, clean-up, maintenance, etc.; (2) the standard printing blanket cylinder; (3) the impression cylinder; and (4) the sheet delivery area, beneath the coating apparatus, housing the conventional Infra-red or UV drying unit. In this second retractable position, the apparatus may be used as a seat by the operator, as desired, for standard printing press unit operation.

A gear cover is provided about the blanket cylinder gear and is designed to resiliently sealingly engage the gear cover of the printing unit to which the coating apparatus is installed. When the coating unit is retracted, a cover is supplied to seal the cutout in the press gear cover. Therefore the integrity of the oil bath is maintained within the press gear cover in both operating and retracted positions of the apparatus.

A specific sequence of actuation of the transfer roll relative to the coating blanket cylinder, and actuation of the coating blanket cylinder (and, therefore, of the entire assembly) relative to the impression cylinder for proper coating operation, is specifically discussed later herein This apparatus is well adapted to be built into a new printing press or to be retrofitted into existing equipment

Other feathers and advantages of the invention will be apparent from the following description of the preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the coating apparatus including a diagrammatic view of a printing press with which it is operatively associated. In this Figure the cylinders of the coating assembly are shown in solid in their coating operating position and in phantom in their retracted position. The coating apparatus is shown in section

FIG 1A is a side view of stop on the coating apparatus of FIG. 1

FIG 2 is a diagrammatic side view of a set of coating application rollers showing details of controls for positively, drivingly, linking these rollers to a printing system; and

FIG. 3 is similar to FIG. 2 showing a schematic view of controls for the coating apparatus hereof for adjustment, actuation and retraction of the coating assembly relative to the press, actuation and adjustment of the transfer roll relative to the coating blanket cylinder and the metering means relative to the transfer roll.

FIG. 4 is a cross-sectional view taken along lines 4—4 from FIG. 1.

FIGS. 5 and 6 are diagrammatic representations of two alternative embodiments of the invention, respectively, in which the coating assembly is engaged with an

impression cylinder retrofit in place of a transfer cylinder.

FIGS 7 and 8 are diagrammatic representations of yet two additional embodiments of the invention, respectively, in which the blanket coater of the invention is employed with a coating tower on either an impression cylinder retrofit at a transfer cylinder of the last press unit, or directly on the impression cylinder of the coating tower

FIG. 9 is diagrammatic illustration of the means of locking the blanket coating cylinder to the press impression cylinder.

FIG. 10 is a diagrammatic illustration of the means of circumferential register adjustment.

FIG. 11 is a diagrammatic illustration of the means of lateral register adjustment.

FIGS 12*a* and 12*b* respectively show the coating assembly adapted to single-sided, and to two-sided, web printing applications.

SPECIFIC EMBODIMENTS OF THE INVENTION

This invention will be described with reference to the drawing in which like parts have been given like reference characters.

Referring now to FIGS. 1 and 4, the coating apparatus assembly of this invention comprises a transfer roller 10, journalled for rotation, onto which is fed coating material 12, and a metering assembly 14 which is suitably adjustably mounted relative to the transfer roll to deliver a predetermined quantity of liquid coating, substantially evenly along the surface of the transfer roller 10 This metering assembly 14 includes a rotatably mounted journal 20 which is generally parallel to the axis of the coating transfer roller 10. Mounted substantially centrally about the journal 20 is a housing 22 from which a blade clamp 24 extends. A doctor blade 26 is positioned in the blade clamp 24 and is angularly positioned against the transfer roller 10. The doctor blade 26 is suitably made of blue spring steel, suitably about ten thousandths of an inch thick, and suitably extends out of the clamp 24 about one half inch. The angular position of the blade 26 may be about 40° to a tangent to the transfer roller surface. It has been found to be useful to force the doctor blade 26 against the transfer roller 10 with a pressure of about one half to one pound per linear inch The transfer roll (with the metering device) is mounted at each end thereof in a common frame 16 which is in turn rotatably supported in a coater assembly housing 46. Frame 16 is pivotally rotated, or otherwise moved, by cylinder 57, not shown, to adjustably engage transfer roll 10 to a lightweight (e.g., aluminum) coating blanket cylinder 40 for proper coating application. Movement of frame 16 does not affect pressure between roller 10 and blade 26. Likewise, movement of housing 46 does not affect the pressure setting, or the relative positions, of transfer roll 10 and coating blanket cylinder 40. Adjustable stop 18 is provided to set a light "kiss" pressure between roller 10 and cylinder 40.

A drip pan 28 having an outlet is provided, and is positioned below the transfer roller 10 and the metering assembly 14 The pressure exerted by the doctor blade 26 against the transfer roller 10 can be adjusted by means of two adjustment screws 27 which extend to corresponding adjustment brackets 29 clamped on the axle 20. It is preferred that the adjustment screws are attached to the brackets off center with respect to the axis of the axle 20 so that the rotation of these adjustment screws will pivot the axle 20 whereby changing the pressure of the doctor blade 26 on the roller 10. A cover may be provided over the coating 12 and roller 10.

A coating blanket cylinder 40 is provided in operative, takeoff contact with the transfer roller 10. The blanket roller has its own journals rotatably mounted, suitably in needle bearings, and supportingly attached to the same housing 46 as supports the common frame 16 for the transfer roller and metering assembly. This housing 46 is slidably mounted on rails 48 which, in a preferred embodiment of this invention, are inclined so as to easily move the coating assembly into and out of the line as well as provide a guide for adjustment and actuation of the coating blanket cylinder (and entire unit) relative to the impression cylinder of the press.

Specifically, the housing 46 is mounted on bearing blocks 50 that are in turn slidably mounted on the two parallel rails 48. The rails 48 are mounted on rail supports 52 which are adapted to be directly connected to the press unit.

Hydraulic cylinders 58 each with an adjustable clevis 62 are mounted on opposite sides of the housing 46 to provide proper actuation and a "kiss" pressure contact between the coating blanket on the special blanket cylinder 40 and the sheet on press impression cylinder 66. Suitably a latch 60 is provided to insure positive positioning and lock-up of the entire coating assembly with relation to the printing unit, i.e., the coating blanket cylinder 40 with the impression roller 66.

Double adjusting screws 30 and 32 are supported by support 36 attached to housing 46. Screw 30 bears against stop block 38, attached to the press frame. Screw 32 is locked by nut 34. Rotation of screw 30 provides for paper pressure adjustment and thickness changes in sheet stock, while setting screw 32 provides a safety such that gears mounted on the coating blanket cylinder and press impression cylinder, cannot be meshed beyond a preset point while in the coating mode of operation. Once nut 34 is tightened, the nut is fixed (as if it were welded or pinned) for a specific screw 32 setting. Clearance "S_c" in FIG. 1 depends on the thickness of the sheet, S_t which is generally between 0.000 to 0.030 inches. As shown in FIG. 1, clevis 62 is adjusted such that a clearance exists within cylinder 58, between the piston and cylinder wall The piston serves as an "OFF" stop for the coating assembly when the assembly is actuated. A separation will therefore exist between the blanket and sheet when in the "OFF" impression position. For a theoretical 0.000 sheet thickness, S_c should be set for 0.060 inches approximately.

A gear-motor 80, which may be hydraulic or electric, is suitably provided to drive the transfer roll 10. Suitable means is provided to retract the coating assembly into and out of operative relation with the impression roller 66, up and down the rails 48.

The coating assembly is shown in cooperative relationship with a conventional series of printing rollers The coating blanket on blanket cylinder 40 is in light "kiss" contact with the sheet on impression cylinder 66, the sheet on the impression cylinder being also in contact with a printing blanket on blanket cylinder 70, impression cylinder 66 thereby serves as a dual impression cylinder, first for printing and next for coating. The sheet work piece is shown at 72.

The coater is first locked into operation on the press unit by lowering it along the rails 48 toward the press unit and engaging clevis 62 to lug 61 mounted on the

press through releasable latch pin 60 In operation, gearmotor 80 mounted on housing 46 rotates the roller 10 as coating fluid is pumped under pressure from a fluid reservoir (not shown) to an inlet opening in the doctor blade assembly. From there, coating spreads over the surface of roller 10 and is distributed by the doctor blade 26. A continuous flow of coating is maintained over the surface of the roller 10 and excess coating is recovered through drip pan 28, with an outlet for recycling. In this way, sufficient flow is maintained to provide a flooded nip of coating between roller 10 and blade 26 and to provide uniformity of coating along the rollers' length. The amount of coating carried by the transfer roller 10 can be adjusted somewhat by turning screws 27 to adjust the pressure between doctor blade 26 (or a metering roller) and the transfer roller 10, as described above Hydraulic cylinders 58 serve to pull the entire unit against the press with a force that can be adjusted by adjusting the pressure in the cylinders 58 Screw 30 adjusts "ON" pressure between the coating blanket on blanket cylinder 40 and a sheet carried on impression cylinder 66 Cylinders 58 further serve to separate the coating blanket cylinder from the impression cylinder while gears mounted on the adjacent cylinders still remain in mesh. Separation or clearance "S_c" in FIG. 1 is about 0.060 to 0.030 inches to provide an "OFF" condition of the coater assembly to stop application of coating. As the blanket cylinder 40 rotates in direction R, coating is applied to the just printed sheet Transfer roller 10 rotates as shown by direction R'.

A uniform amount of liquid coating is continuously transferred to the blanket roller 40 at the nip between the blanket roller 40 and the transfer roller 10. The blanket roller 40 in turn delivers that coating to the workpiece as the workpiece travels through the nip between the blanket roller 40 and the impression roller 66. Changing the speed of roller 10 results in a change of coat weight added to the sheet

When the coater is not in use, latch pin 60 is released, and a suitable means moves the coating unit back along the rails 48 away from the printing rollers

More specifically, when using an acrylic water-based coating, a suitable transfer roller may be a quadrangular cell cylinder, having about 140 lines/inch, each square inch of cells carry 15 cubic billion microns of coating A suitably engraved roller is sold by Pararco Roller Co of Dallas, Tex (Exact roll cell nomenclature is: 140 Rotoflo/138 for an optimum roll surface structure.) An acrylic water-based coating having about 45% solids can be applied to achieve an optimum dry coat weight of ~0.4–0.6 pounds per 1000 square feet, using a roll surface speed of 1:1 with that of coating blanket roll 40.

Referring now to FIG 2, there is shown a portion of a coating apparatus assembly including transfer roller 10, coating material 12 fed from a supply thereof 13 and metered onto the roller by means of a doctor blade assembly 14, including a drip pan 28. The transfer roller 10 is suitably driven by direct drive gear motor 80 whose speed is controlled by a controller 82 responding to sensor 84 which senses the speed of the coating blanket cylinder 40. Controller 82 is adjusted to provide a preset surface speed ratio, 1:1 or less, between roller 10 and cylinder 40, the slowest surface being that of roller 10 Impression cylinder 66 includes a sheet gripper 95 The coating blanket on blanket cylinder 40, and associated drive gear 40 , preferably have the same operative diameter as the impression cylinder 66 and press gear 66' Gear 40 is directly driven by press gear 66' of cylinder 66 so as to insure a positive synchronized drive relation there between. In FIG. 2, no worksheet is shown in this figure for clarity Index marks are placed on adjacent gears to insure proper register of adjacent cylinders. The gear pitch line separation "P.L.S." is approximately equal to the sheet thickness "Sht.Thk.", S_t, shown on cylinder 66. D_{40} is a broken line corresponding to the outer diameter of the blanket on cylinder 40, and the pitch line of gear 40 and D_{66} is a broken line corresponding to the outer diameter of impression cylinder 66 and the pitch line of gear 66'. R_{40} is equal to R_{66} and thus D_{40} and D_{66} are equal.

Referring now to FIG. 3 which is similar to FIG. 2, there is shown the same three rollers, the transfer roller 10, the coating blanket cylinder 40 and the dual, common, impression roller 66 The transfer roller 10 and the coating blanket roll 40 are shown commonly mounted in assembly 46 via bearing blocks 50, on inclined rails 48. There is shown in this figure a first cylinder 57 with stop 18 which adjusts the pressure in the nip 90 between the transfer roller 10 and the coating blanket on blanket cylinder 40. A second cylinder 58 and screw 30 are provided to control the spacing in the nip 94 between the coating blanket on the blanket cylinder 40 and the dual impression cylinder 66 to accommodate a particular sheet thickness. The last color printing blanket roll 70 is not shown for clarity Frame 16 pivots at P in FIG. 3.

FIG. 4 is a sectional view taken along lines 4—4 of FIG. 1 showing relationship or roll lengths to each other, a cover A' about the coating blanket cylinder drive gear, lateral and circumferential register provisions for the coating blanket cylinder, B' and C' respectively and other component parts shown in FIG. 1.

As best shown in FIG. 4, housing 46 is offset to the inside of the press frame in the area of the bearings for coating cylinder 40, and therefore clears the press frame in this area. The remainder of the housing may lie along the inclined surface of the frame: that is, directly above the frame. This offsetting of housing 46 prevents having to alter (cut away) a portion of the press frame adjacent the bearing

For sequencing of rolls for proper coating operation, the following procedure is followed:

"ON"	1	Transfer roll actuates to coating blanket cylinder upon actuation of press blanket cylinder of last printing unit
	2	Coating blanket cylinder actuates to sheet on press impression cylinder upon one full revolution of press
"OFF"	1.	Transfer roll separates from coating blanket cylinder upon actuation of blanket cylinder of preceding press unit:
	2	Coating blanket cylinder separates from the sheet on the press impression cylinder upon actuation of the press blanket cylinder of the last printing unit

An alternate embodiment is shown in FIG 5, which is particularly applicable for press units which cannot accommodate a coating assembly according to the invention in operable association with the press unit blanket cylinder as described above. In FIG. 5, an impression cylinder is installed downstream of the final press unit, in place of a sheet transfer cylinder which ordinarily transfers the workpiece along a path from the final unit to the press delivery.

Specifically, press units **100** and **101** generally correspond to the Miehle Super 60" press. The positioning of certain cylinders in that press does not permit installation of a coating assembly as described in the embodiment of FIG. 1. Existing press unit **101** includes sheet transfer cylinders **102**, an impression cylinder **103**, and plate and blanket cylinders **104** and **105**. Ordinarily, the cylinders at positions **106** and **107** are also sheet workpiece transfer cylinders to transfer the workpiece from the final unit **101** to the delivery area **120**.

According to the invention, the sheet transfer cylinder ordinarily occupying position **106** is replaced by an impression cylinder which cooperates with a retractable coating assembly having a coating blanket cylinder **140** as described above. Other components of the coating assembly of FIG. **5** (e.g., transfer cylinder **110** and metering assembly **114**) are the same as described above and require no further description. The operation of the apparatus of FIG. **5** is analogous to the operation of the above-described apparatus of FIGS. **1-4**, and the coated sheet is transported to the press delivery.

FIG. **6** shows a similar arrangement for a small (25") Heidleberg MO ® press, in which a double-size sheet transfer cylinder at position **201** has been replaced with a double-size impression cylinder. A retractable coating assembly **202** according to the invention is positioned in operative association with the impression cylinder at **201**. Coating assembly **202** includes a coating blanket cylinder **240** and a coating transfer cylinder **210**.

FIG. **7** shows an arrangement featuring the use of a coater on a press that includes a Heidleberg coating tower **301** downstream from the final press unit. The coating tower includes a standard coating unit **302**, having an application cylinder **303** which applies coating to a workpiece nipped between application cylinder **303** and coating impression cylinder **309** for applying a coating. A retractable coating assembly **304** according to the invention can be added by replacing the transfer cylinder at position **303** with an impression cylinder, and adding the coating assembly **304** upstream from the standard unit **302**. Coating assembly **304** includes a retractable blanket cylinder **340** and a coating transfer cylinder **310**, each of which is substantially similar to the coating cylinders described in FIGS. **1-4**. The workpiece is transferred via transfer cylinder **308** to coater **301**. In this way, it is possible to apply a water-based pre-coat to the sheet workpiece at unit **304**, upstream from the application of a U.V. sensitive coating at standard unit **302**. The precoating is dried before the U.V. coating is cured at station **307**. After coating, the sheet is presented to the press delivery **320** in the standard way. Such a double coating system is particularly useful where the ink and the U.V. coating are not compatible, requiring the intermediate pre-coating layer to separate them.

FIG. **8** shows an alternative retrofit of the coating tower shown in FIG. 7. Specifically, the cylinder in position **403** is a standard transfer cylinder. Coating impression cylinder **404**, which is part of the standard coating unit **402** serves to apply a second layer of coating from the coating assembly **405** according to the invention, which is retrofit to work in cooperation with impression cylinder **404** Coating assembly **405** includes a blanket cylinder **440** and a transfer cylinder **410** as described above The remainder of the coating tower and delivery is generally as described for FIG. 7, and further description is not necessary here. The embodiment of FIG. **8** is useful for applying a double layer of coating at a single impression cylinder, with the first layer being applied by the standard coating unit **402** and the second layer being applied as described above.

Another alternate embodiment is shown in FIGS. **9-11** which includes alternative features of the coating unit embodiment illustrated in FIGS. **1-4**.

A different method of "locking" the coating unit (e.g. the unit of FIG. **3**) to the press is illustrated in FIG. **9**. The coating unit is displaced down the rails **48** by means of a hydraulic cylinder **500**. Once in the vicinity of the press, electromagnets **502**, **504**, located on the press and the coating unit, respectively, mate and attach the coating unit to the press. These electromagnets act to maintain the relative positions of the two units and therefore serve to replace latch pin **60**, lug **61**, and clevis **62**.

Before attaching the coating unit, a registering process is initiated. Registering refers to aligning the coating unit with the press in an operative position More specifically, registering aligns the teeth of gear **66'** attached to the press impression cylinder **66** to those of another gear **40'** attached to the coating blanket cylinder **40**. Additionally, when the gears have been properly aligned, the sheet gripper is in its proper position relative to (and is registered with) the blanket gripper and gap on cylinder **40**. Proximity sensors **506**, **508** (or their equivalent) are attached to gear **66'** and gear **40'**, respectively, and are placed near the perimeter of the gears. Both gears **66'**, **40'** are rotated relative to one another until these sensors **506**, **508** are in their nearest proximity, indicating proper orientation. The gear teeth are then brought together in a mesh configuration, and index marks of FIG. **2** will be as shown.

Gear **40'**, attached to the coating blanket cylinder, is made of a resilient plastic material (i.e. MC901 Nylon). The purpose of manufacturing the gear out of plastic is to avoid problems associated with uneven gear wear. Metal gears in a gear train that have differencing amounts of wear may not mesh properly and may cause poor quality printing. Therefore, all metal gears in a gear train are usually replaced concurrently so that wear is matched for all gears in a set. A plastic gear on the retrofit blanket cylinder can adjust to the wear of the press gear **66'** because of its ductile and resilient qualities. Therefore, coating unit gear **40'** can be maintained independently of press gear **66'** and can be retrofitted or replaced independent of the state of wear of press gears without interfering with the quality of the printed material.

When the coating unit is locked to the press, it sometimes becomes necessary to realign the coated blanket cylinder **40** without separating the coating unit from the press. Therefore, both circumferential and lateral adjustments are possible.

Means for circumferential adjustments are illustrated in FIG. **10**. The gear **40'** attached to the coating blanket cylinder **40** includes a hub **650**. Atop the hub **650** is a face plate **652** which is secured to the coating blanket cylinder shaft **654** (shown on end view). Four bolts **658'**, attached to the hub **650** extend out of the hub through four machined slots **656** in the face plate **652** Four nuts **658** are tightened on the bolts and are utilized to fasten the face plate **652** and shaft **654** to the gear hub **650**, thereby fixing the rotational orientation of the coating blanket cylinder **40** to the gear **40'**. To adjust the cylinder orientation with respect to the fixed gear position, the nuts **658** are loosened, and the face plate **656** and shaft **654** are rotated relative to the gear hub. Appar-

ently, the limits of rotation are defined by the circumferential length of the machined slots 656

Means for lateral adjustments are illustrated in FIG 11 Coating blanket cylinder 40 is attached to a shaft 654 at both ends. Gear 40' is mounted on one end of this shaft 654 (as described above). The lateral position of the cylinder 40 is maintained via shaft collars 600. The shaft collars 600 are placed on opposite ends of the shaft, and when secured, do not allow for lateral motion of the cylinder with respect to the shaft. Cylinder 40 is preferably keyed to the sheet 654 to prevent circumferential movement of the cylinders relative to the shaft. These collars have internal threads, and the shaft hollow tubes having an inner diameter is threaded externally

Each shaft collar 600 includes inner screw threads which mate with outer screw threads 602 contained on the shaft 654 To move the cylinder 40 in a lateral direction, shaft collars 600 are loosened on the cylinder which specifically entails rotating these collars on their threads away from the cylinder, to free the cylinder to be laterally displaced on the shaft in either direction. When a desired position is achieved, the cylinder 40 is again tightened to the shaft 654 by rotating the shaft collars 600 on their threads toward the cylinder and into a tight fit against the cylinder. The force of the shaft collars against the cylinder act to lock the cylinder in a fixed lateral orientation relative to the shaft.

FIGS. 12*a* and 12*b* show the coating unit adapted for two different web offset presses to coat, e g. with a U.V coating). In FIG. 12*a*, press unit 701 is a single-sided web offset lithographic press, having a printing blanket cylinder 702 and an impression cylinder 703 for printing web workpiece 704. Coating unit 705 includes metering cylinder 706 and blanket cylinder 707, as described above

In FIG. 12*b*, press unit 801 is a double sided (blanket-to-blanket) web offset lithographic press unit in which blanket cylinders 802 and 803 print opposite sides of web workpiece 804 simultaneously. Coating unit 805 operates in associating with blanket cylinder 803 to coat the top side of web 804.

OTHER EMBODIMENTS

Other embodiments are within the following claims For example, other doctor blade arrangements may be used to doctor the coating from the transfer roller 10, such as a system utilizing a reverse angle blade or having dual blades and having a coating inlet between the two blades. A roll, or roller means, may also replace the doctor blade arrangement. Other types of engraved or smooth surfaced cylinders may be used. Those skilled in the art will appreciate that the coating unit described above may be adapted to achieve numbering, slitting, scoring, and the like. Moreover, the coating unit described above may be used to deliver varnishes, coatings, glues, dyes, etc. in addition to coatings. Other types of presses may be used in conjunction with the coater, but offset lithographic sheet-feeding presses are preferred For example, the coating unit may be adapted to web offset press printing

What is claimed is:

1. A coating apparatus for applying a liquid coating to a workpiece in co-operation with an impression cylinder mounted on a lithographic printing press, said press having at least one ink carrying surface for applying ink to said workpiece prior to coating, said coating apparatus comprising,

a) an independent, cooperatively operating coating assembly comprising:
  i) a liquid coating supply means.
  ii) a coating carrier which includes a resilient coating carrying surface for carrying liquid coating.
  iii) a means for metering and transferring liquid coating, operatively connected between said coating supply and said carrying surface, for maintaining a controlled amount of liquid coating on said coating carrying surface; and
  iv) structural members integrating said means for metering and transferring liquid coating and said coating carrier into said coating assembly:
b) supports for allowing movement of said coating assembly between: i) an operative position in which said coating surface on said carrying surface is in rotative pressure contact with a workpiece on said press unit impression cylinder; and ii) a fully retracted position in which said coating assembly is completely disengaged from said press unit impression cylinder at a location remote from the press unit impression cylinder, said coating assembly, including said coating carrier and said means for metering and transferring coating material, remaining connected during said movement,

whereby, in said operative position, said carrying surface continuously delivers a smooth, uniform, metered amount of said liquid coating material to said workpiece on said impression cylinder.

2. The coating apparatus of claim 1 in which said coating assembly comprises:

a) a roller means for metering and transferring a uniform predetermined quantity of coating to said resilient carrying surface on said coating carrier, said coating supply means being operatively associated with said roller means;
b) a movable support for said coating carrier, for moving said coating carrier into and out of contact with said workpiece on said impression cylinder,
c) a movable support for said roller means for moving said roller means into and out of contact with said coating surface on said coating carrier,
d) means for integrating said coating carrier and said roller means into said coating assembly:
e) means for independently actuating said coating carrier movement and said roller means movement;
f) means for independently adjusting pressure between said coating surface on said coating carrier and said workpiece on said impression cylinder and pressure between said roller means and said coating surface on said coating carrier; and
g) means for integrating said coating assembly with said impression cylinder in said operative position, such that a change in pressure between said carrying surface on said coating carrier and said workpiece on said impression cylinder, or actuation of said carrier into and out of contact with said workpiece, does not alter pressure between said roller and said coating carrier; and such that a change in pressure between said roller means and said carrying surface on said coating carrier, or actuation of said roller means into and out of contact with said coating surface on said coating carrier, does not alter pressure between said coating surface on said coating carrier and said workpiece on said impression cylinder.

3. The coating apparatus of claim 1 in which said coating assembly comprises.

a) support and retraction means for said coating assembly allowing movement of said coating assembly between at least three positions, a first position in which said coating surface on said coating carrier is operatively engaged with a workpiece on said press unit impression cylinder, a second (off-impression) position in which said coating surface on said coating carrier is separated somewhat from said workpiece on said press unit impression cylinder, and a third (storage) position in which said coating assembly is removed away from the impression cylinder, allowing access to said press; said coating assembly, including said means for metering and transferring coating material, remaining connected during movement of said coating carrier as part of said coating assembly.

4. The apparatus of claim 1, claim 2, or claim 3 wherein said impression cylinder is operatively associated with a printing blanket cylinder positioned in a printing unit of said printing press, whereby, in operation, a workpiece on said impression cylinder contacts said printing blanket at a first workpiece location while it contacts said coating surface on said coating carrier at a second workpiece location, enabling simultaneous printing and coating at said impression cylinder.

5. The apparatus of claim 1 wherein said coating assembly is mounted on an inclined support

6. The apparatus of claim 1 further comprising a means for moving the coating assembly toward or away from the press unit.

7. The apparatus of claim 6 wherein the means for moving the coating assembly comprises a hydraulic cylinder.

8. The apparatus of claim 1 wherein said means for metering and transferring coating comprises a transfer cylinder in operative contact with said coating surface on said coating carrier and means for metering the amount of coating carried on said transfer cylinder.

9. The apparatus of claim 8 including means to control the nip between said transfer cylinder and said coating surface on said coating carrier.

10. The apparatus of claim 1 including a gear positively coupling said coating carrier to said impression cylinder when said coating assembly is in said first operating position

11. The apparatus of claim 10 wherein said gear comprises a plastic material.

12 The apparatus of claim 1 wherein the impression cylinder comprises a gear adapted to drive a gear for the coating carrier.

13. The apparatus of claim 10 further comprising means of registering the gear for the coating carrier with the adjacent impression cylinder gear.

14. The apparatus of claim 13 further comprising sensors on said coating carrier gear and said impression cylinder gear to rotationally align said gears with one another

15. The apparatus of claim 1 further comprising means for adjusting the position of the coating carrier relative to the impression cylinder, while the coating carrier remains drivingly engaged with the impression cylinder.

16. The apparatus of claim 8 or 9 comprising an adjustable stop to control the nip between the coating surface on said coating carrier and the workpiece on said impression cylinder, without changing the coating carrier relationship to the liquid coating metering and transfer means.

17. The apparatus of claim 1 wherein said coating carrier further comprises means for register adjustment with the adjacent press impression cylinder.

18 The apparatus of claim 17 wherein the register adjustment comprises a plurality of bolts corresponding to slots, which cooperate to allow for movement of the coating carrier with respect to a gear for the coating carrier.

19. The apparatus of claim 17 wherein the coating carrier further has means enabling lateral register adjustment relative to the adjacent press impression cylinder.

20. The apparatus of claim 19 wherein the lateral register adjustment means comprises threaded collars adapted to allow for lateral movement of the coating carrier located at both ends of said coating carrier relative to a shaft extending through and supporting the carrier, said shaft being fixed against lateral movement.

21. The apparatus of claim 1 wherein said impression cylinder is retrofit into a position in said printing press ordinarily occupied by a workpiece transfer cylinder.

22. The apparatus of claim 21 in which said position of said impression cylinder is retrofit in place of a workpiece transfer cylinder positioned to transfer said workpiece to a fixed coater.

23. The apparatus of claim 1 wherein said printing press is connected to a fixed coater and said impression cylinder is an impression cylinder that forms part of said coater.

24 The apparatus of claim 1 further comprising a means of locking the coating assembly to the press unit

25 The apparatus of claim 24 wherein the means of locking comprises a clevis and a press-mounted lug cooperatively sized and positioned to engage said clevis, and a releasable latch pin adapted to connect said clevis to said lug.

26. The apparatus of claim 24 wherein the means of locking comprises a pair of cooperatively sized and positioned electromagnets.

27. The apparatus of claim 2 comprising

means to positively rotate said roller means,

means to positively rotate said coating surface on said coating carrier in registration with said workpiece supported and conveyed on said impression cylinder,

sequencing means, cooperatively associated with the means for actuating, for sequentially actuating movement of said roller to said coating surface on said coating carrier, before actuating movement of said coating surface on said coating carrier to engage said printed workpiece on said impression cylinder, and for sequentially actuating movement of said roller away from said coating surface on said coating carrier before actuating movement of said coating surface on said coating carrier away from said workpiece.

28. The apparatus of claim 1 comprising means to vary the surface speed of at least one roller in the roller means relative to the surface speed of the carrier.

29 The apparatus of claim 1, claim 2, or claim 3, wherein said coating carrier is a coating blanket cylinder or a coating plate cylinder.

30 The apparatus of claim 1, claim 2, or claim 3, wherein said coating carrier presents a gapped coating surface to said impression cylinder as said impression cylinder rotates, and said printing ink carrier presents a gapped printing surface to said impression cylinder as said impression cylinder rotates, said coating surface

(including said gap therein) having a perimeter substantially equal to the perimeter of said printing surface (including said gap therein).

31. The apparatus of claim 1, claim 2 or claim 3 wherein the coating carrier is a coating plate cylinder carrying a plate.

32. The apparatus of claim 1, claim 2 or claim 3 wherein the impression cylinder is a standardly supplied impression cylinder supporting a workpiece being printed on a lithographic printing press unit.

33. The apparatus of claim 1, claim 2, or claim 3, wherein the impression cylinder is retrofit in place of a standardly supplied transfer cylinder on a lithographic printing press unit.

34. The apparatus of claim 2 wherein means supporting and integrating comprises a first pair of frames supporting said moveable support means for said carrier and said roller means, including said support actuating means and adjustment means, where said pair is minutely adjustable, actuatable and relocatable to a remote position from said impression cylinder, said impression cylinder being supported by a second pair of frames.

35. The apparatus of claim 34 wherein said actuation means for said first pair of frames include a pair of hydraulic cylinders.

36. The apparatus of claim 2 wherein said means for independently adjusting pressure includes stops and screws for adjusting pressure between said coating surface on said coating carrier and said workpiece on said impression cylinder, associated with means to limit pressure therebetween.

37. The apparatus of claim 2 wherein the roller means comprises an engraved anilox roll having an engraved cell structure with a maximum capacity of approximately 15 billion cubic microns per square inch for carrying a water-base acrylic coating having a solids content of approximately 45% to apply a dry coat weight to said sheet workpiece of approximately 0.4 to 0.6 lbs/1000 Ft^2 when the anilox roll has a surface speed approximating that of the resilient coating surface of the coating carrier.

38. Apparatus for applying a uniform and smooth liquid coating, on line, to a printed workpiece in a multicolor sheet-fed lithographic printing press wherein coating is applied to said workpiece while said workpiece is supported and conveyed by an impression cylinder of said press, said coating being applied over wet ink, said apparatus comprising:

- a coating carrier supporting a resilient coating surface in rotative pressure contact with said printed sheet workpieces;
- roller means for metering and transferring a uniform predetermined quantity of coating to said resilient coating surface on said coating carrier;
- coating supply means operatively associated with said roller means,
- means supporting said coating carrier, said roller means and said coating supply means, into a cooperatively operable coating assembly;
- means to adjust pressure between said resilient surface on said coating carrier and said sheet workpiece;
- means to adjust pressure between said roller means and said coating carrier;
- means to rotate said coating carrier such that said resilient surface of said carrier rotates with said sheet workpiece to apply a uniform, smooth coating over wet ink on said sheet workpiece
- means to rotate said roller means;
- means to actuate said coating carrier from said sheet workpiece to an off-impression position;
- support and guide means for said coating assembly attached to said press;
- and, means to retract said coating assembly including said coating carrier, said roller means and said coating supply means, to a remote position substantially away from said impression cylinder, to provide access to said press upon movement of said coating apparatus.

39. A method for printing and coating a workpiece, by transmitting said workpiece through a coating apparatus in cooperation with an impression cylinder mounted on a lithographic printing press, said coating apparatus comprising

a) an independent, cooperatively operating coating assembly comprising:
   i) a liquid coating supply means;
   ii) a coating carrier which includes a resilient coating carrying surface for carrying liquid coating;
   iii) a means for metering and transferring liquid coating, operatively connected between said coating supply and said carrying surface, for maintaining a controlled amount of liquid coating on said coating carrying surface, and
   iv) structural members integrating said means for metering and transferring liquid coating and said coating carrier into said coating assembly;
b) supports for allowing movement of said coating assembly between: i) an operative position in which said coating surface on said carrying surface is in rotative pressure contact with a workpiece on said impression cylinder; and ii) a fully retracted position in which said coating assembly is completely disengaged from said impression cylinder at a location remote from the impression cylinder, said coating assembly, including said coating carrier and said means for metering and transferring coating material, remaining connected during said movement.

whereby, in said operative position, said carrying surface continuously delivers a smooth, uniform, metered amount of said liquid coating material to said workpiece on said impression cylinder.

40. The method of claim 39 in which said impression cylinder is operatively associated both with a printing carrier at a first location on said workpiece and with said coating carrier at a second location on said workpiece, to simultaneously print and coat said workpiece at a single impression cylinder.

41. The method of claim 39 in which said printing press includes a coater for providing a U.V. curable coating, and said coating assembly coats with a precoat, prior to application of said U.V. curable coating by said coater.

42. The method of claim 39 in which said printing press includes a fixed coater comprising a fixed coater impression cylinder operatively connected to a coater blanket cylinder and to said coating assembly carrier, whereby said method comprises coating said workpiece with two coating layers at said fixed coater impression cylinder.

43. A method for applying a liquid coating to a workpiece, using a coating apparatus operating on line with an impression cylinder of a lithographic printing press,

said press having at least one ink carrying surface for applying ink to said workpiece prior to coating, said coating apparatus comprising: a) a coating carrier adapted to carry a resilient coating surface in rotative pressure contact with said workpiece supported by said impression cylinder; b) a roller means for metering and transferring a uniform predetermined quantity of coating to said resilient coating surface on said coating carrier; c) coating supply means operatively associated with said roller means; d) a movable support for said coating carrier for moving said coating carrier into and out of contact with said workpiece on said impression cylinder; and a movable support for said roller means for moving said roller means into and out of contact with said coating surface on said coating carrier, said coating carrier and said roller means being integrated into a unitary assembly; said method comprising:

a) independently actuating said coating carrier movement on the one hand and said roller movement on the other hand;

b) independently adjusting pressure between said coating surface on said coating carrier and said workpiece on said impression cylinder and pressure between said roller means and said coating surface on said coating carrier; and

c) integrating said impression cylinder with said assembly, such that a change in pressure between said coating surface on said coating carrier and said workpiece on said impression cylinder, or actuation of said carrier into and out of contact with said workpiece, does not alter pressure between said roller means and said coating carrier, and such that a change in pressure between said roller means and said coating surface on said coating carrier, or actuation of said roller means into and out of contact with said coating surface on said coating carrier, does not alter pressure between said coating surface on said coating carrier and said workpiece on said impression cylinder

44. The apparatus of claim 4, wherein said coating carrier is a coating blanket cylinder or a coating plate cylinder.

45 The apparatus of claim 4, wherein said coating carrier presents a gapped coating surface to said impression cylinder as said impression cylinder rotates, and said printing ink carrier presents a gapped printing surface to said impression cylinder as said impression cylinder rotates, said coating surface (including said gap therein) having a perimeter substantially equal to the perimeter of said printing surface (including said gap therein).

46. The apparatus of claim 4, wherein the coating carrier is a coating plate cylinder carrying a plate

47. The apparatus of claim 4, wherein the impression cylinder is a standardly supplied impression cylinder supporting a workpiece being printed on a lithographic printing press unit.

48. The apparatus of claim 16 wherein said adjustable stop includes stops and screws for adjusting pressure between said coating surface on said coating carrier and said workpiece on said impression cylinder, associated with means to limit pressure therebetween.

49 Coating apparatus operating on line with an impression cylinder of a lithographic printing press to apply liquid coating to a workpiece, said press having at least one ink carrying surface for applying ink to said workpiece prior to coating, said coating apparatus comprising: a) a coating carrier adapted to carry a resilient coating surface in rotative pressure contact with said workpiece supported by said impression cylinder; b) a roller means for metering and transferring a uniform predetermined quantity of coating to said resilient coating surface on said coating carrier; c) coating supply means operatively associated with said roller means; d) a movable support for said coating carrier for moving said coating carrier into and out of contact with said workpiece on said impression cylinder, e) a movable support for said roller means for moving said roller means into and out of contact with said coating surface on said coating carrier; f) means for independently actuating said coating carrier movement on the one hand and said roller movement on the other hand; g) means for independently adjusting pressure between said coating surface on said coating carrier and said workpiece on said impression cylinder and pressure between said roller means and said coating surface on said coating carrier; h) means for integrating said impression cylinder with said assembly, such that a change in pressure between said coating surface on said coating carrier and said workpiece on said impression cylinder, or actuation of said carrier into and out of contact with said workpiece, does not alter pressure between said roller means and said coating carrier, and such that a change in pressure between said roller means and said coating surface on said coating carrier, or actuation of said roller means into and out contact with said coating surface on said coating carrier, does not alter pressure between said coating surface on said coating carrier and said workpiece on said impression cylinder;

said coating carrier and said roller means being integrated into a unitary assembly

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US005189960A

United States Patent [19]

Valentini et al.

[11] Patent Number: 5,189,960

[45] Date of Patent: Mar. 2, 1993

[54] APPARATUS AND METHOD FOR CONTROLLING TEMPERATURE OF PRINTING PLATE ON CYLINDER IN ROTARY PRESS

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[51] Int. Cl.[5] B41F 23/04

[52] U.S. Cl. 101/487; 101/349; 101/216; 165/89

[58] Field of Search 101/487, 424.1, 349, 101/350, 216; 165/89, 36, 30; 236/12.13; 34/13, 62

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Assistant Examiner—Lynn D. Hendrickson
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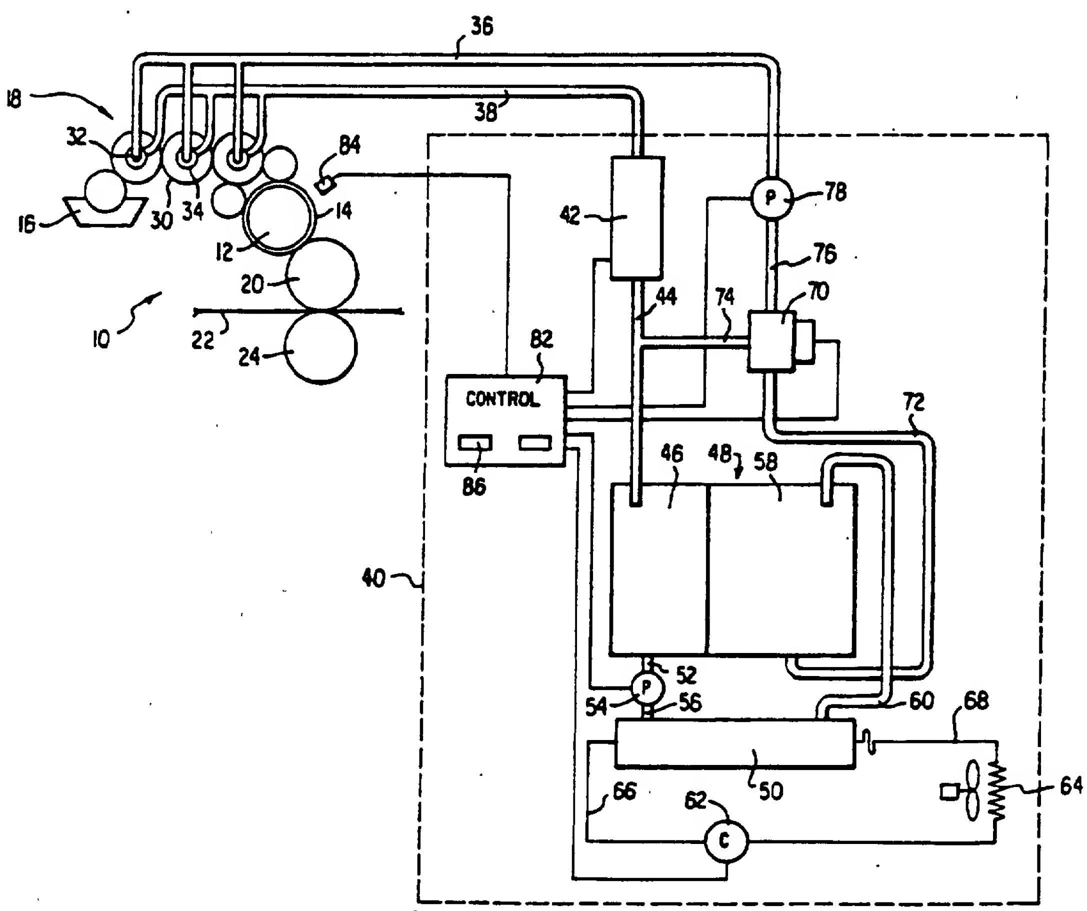
[57] ABSTRACT

In a rotary press, temperature of a printing plate is sensed by an infrared temperature sensor mounted in close proximity to a cylinder carrying the printing plate. Sensor output is used to control a closed loop of a water circulating system which includes one or more water-carrying rollers in an ink train. A water cooler and a water heater are provided in the closed loop and are controlled in response to the sensor output to maintain the printing plate at a temperature which allows proper inking thereof.

8 Claims, 1 Drawing Sheet



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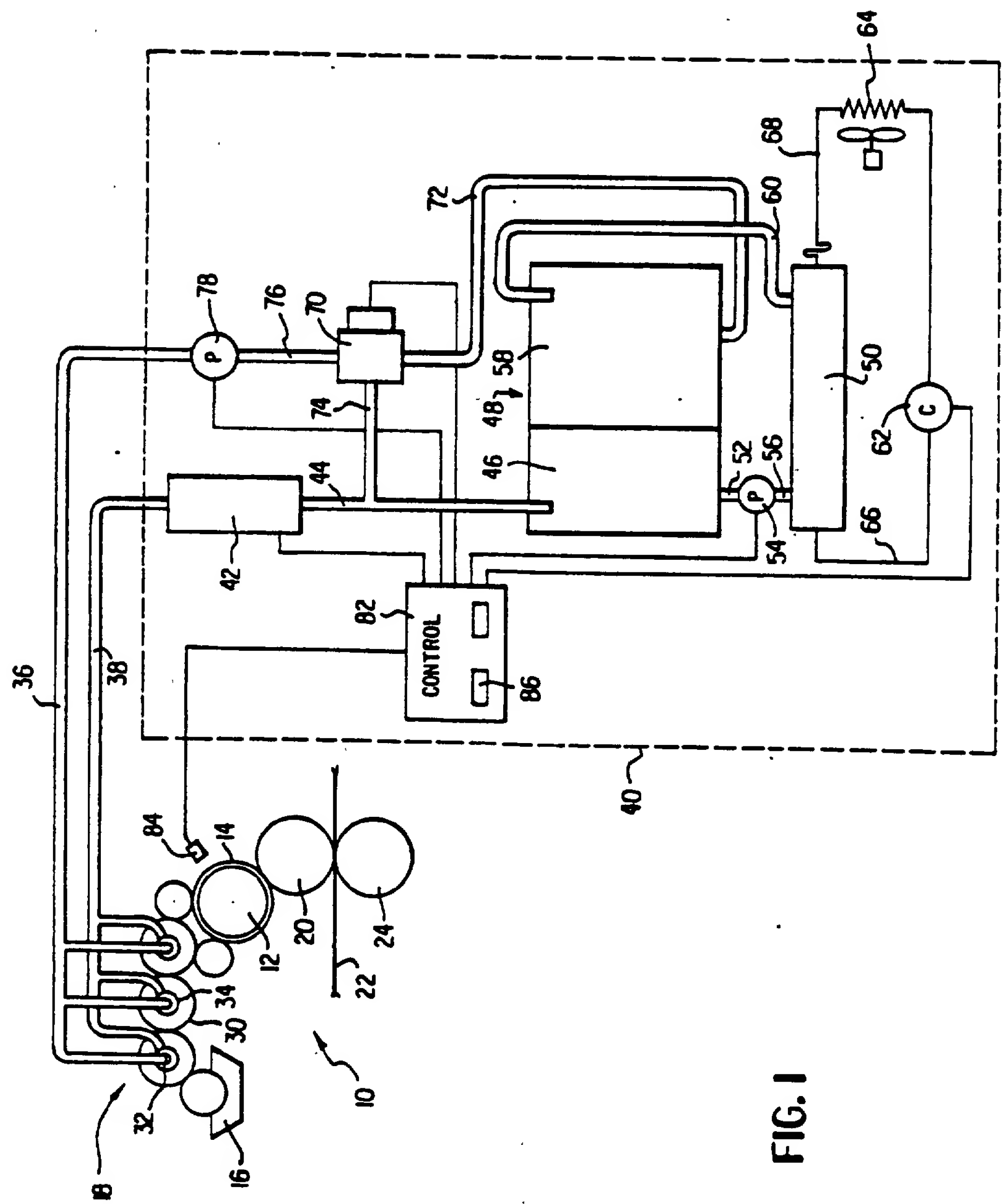
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FIG. I

APPARATUS AND METHOD FOR CONTROLLING TEMPERATURE OF PRINTING PLATE ON CYLINDER IN ROTARY PRESS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to rotary printing presses and, more particularly, to the control of the temperature of the plate on a cylinder in such presses.

2. Description of the Related Art

The temperature of the plate on a cylinder of a rotary printing press is important in maintaining printing quality as the ability to achieve proper inking of the plate is related to temperature. If the plate temperature is too high, the ink viscosity drops. Thus, the ink breaks down and tends to adhere to the nonimage bearing areas of the plate. Improper inking may also occur when the plate temperature is too low.

U.S. Pat. No. 2,971,460 issued to Shindle in 1961 and discloses a system for controlling ink roller temperature in a printing press by means of water circulating through the hollow interior of the rollers. This system is primarily concerned with heating of the rollers with heat extracted from web cooling rollers. When cooling of the inking rollers is necessary, the system relies on the use of cold water from an external source with the subsequent discharge of the water to a drain. However, such an open circulation system is wasteful of water.

Temperature control in the Shindle system is by way of thermostatic valves which are responsive to the water temperature which is, effectively, only an indirect measurement of the inking roller temperature.

Modern rotary presses and the inks used therewith are such that cooling, rather than heating, of the inking train and printing plate has primary importance. It is, accordingly, a primary object of the present invention to provide a system for effecting such cooling in an efficient, water-conserving manner.

In the printing process, the critical temperature for proper inking is that of the printing plate itself. It is also a principal object of the present invention to provide a temperature control system which is directly responsive to the plate temperature.

A further object of the invention is the provision of such a temperature control system which is capable of either cooling or heating the printing plate.

SUMMARY OF THE INVENTION

The above and other objects of the invention will become apparent hereinafter and are achieved by the provision of a plate temperature control system for a rotary printing press. This system includes a closed loop water circulating system including one or more, preferably three, hollow, water-carrying rollers in the ink train of the press, a water heater, a water cooler, a controlled mixing valve, and a circulating pump; an electrical control system for the water heater, water cooler, mixing valve and pump; and an infrared temperature sensor being mounted in close proximity to the plate cylinder of the press to detect its temperature. The sensor also provides input to the control system.

For a more complete understanding of the invention and the objects thereof, reference should be made to the accompanying drawing and the following detailed description wherein a preferred embodiment of the invention is illustrated and described.

DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1, the sole FIGURE, is a schematic showing of a rotary printing press and the plate temperature control system of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Generally, a rotary offset printing press 10, with the exception of the temperature control system of the present invention, has a conventional design and construction. Such a press 10 includes a plate cylinder 12 which carries, on the circumferential face thereof, a printing plate 14. Ink is furnished to the plate 14 from a fountain 16 by way of an ink train 18 consisting of a plurality of inking rollers 30. As is well known, the plate 14 is etched so as to be ink receptive only in those areas which are to be printed. From the plate 14, the ink is transferred to a blanket cylinder 20 and then to a sheet or web 22 of paper or the like brought into contact therewith by an impression cylinder 24.

As was discussed above, proper inking of the plate 14, so as to provide quality printing, is dependent, in part, on the ink temperature as it is applied to the plate 14. Excessive temperature causes a lowering of ink viscosity and a break down of the ink with smearing of the ink onto the nonprinting regions of the plate 14. Improper inking of the plate 14 may also occur when the ink temperature is too low, as may be the case during startup or after the press 10 has been shutdown for a long period of time.

In accordance with the present invention, a closed loop water circulating system responsive to the temperature of the printing plate 14 is provided to maintain the desired plate temperature and, accordingly, the temperature of the ink applied thereto. In this system, one or more, preferably three, of the rollers 30 of the ink train 18 are hollow and are provided with rotary water inlet and outlet connections 32 and 34, respectively, whereby water is circulated within the rollers 30 in heat exchange therewith. The details of such rollers 30 and rotary connections 32 and 34 are well known and need not be further described herein.

Supply and return conduits 36 and 38, respectively, connect the rollers 30 to a water circulating and cooling/heating unit 40. Water entering the unit 40 from conduit 38 flows first through a water heater 42 which is, preferably, a flow-through electric heater, to a pipe 44 leading to an inlet chamber 46 of a dual chamber reservoir 48. A water chiller 50 has its inlet connected to the inlet chamber 46 by a pipe 52, a first circulating pump 54, and a pipe 56. The water chiller 50 has its outlet connected to an outlet chamber 58 of the reservoir 48 by a pipe 60. The chiller 50 is connected to a refrigeration system including a compressor 62 and a condenser 64 via refrigerant lines 66 and 68, respectively. A controllable mixing valve 70 has its first inlet connected by piping 72 to the outlet chamber 58 of the reservoir 48 and its second inlet connected to a pipe 74 which branches from the pipe 44. The outlet of the valve 70 is connected by piping 76 to a second circulating pump 78 which, in turn, has its outlet connected to the supply conduit 36.

The cooling/heating unit 40 is capable of circulating either cooled or heated water through the rollers 30 of the ink train 18 in order to maintain the ink at the desired temperature for proper inking of the plate 14.

Operation of the unit 40 is regulated by an electrical control unit 82 in accordance with the temperature of the printing plate 14. A plate temperature sensor 84 provides an input to the control unit 82. In the preferred embodiment, this sensor 84 is an infrared sensor mounted in close proximity to the periphery of the printing plate 14 of the cylinder 12, preferably midway between the ends thereof. It will be appreciated, however, that other types of sensors for detecting the temperature of the printing plate 14 may be employed. The control unit 82 is provided with an appropriate input device 86 by which the desired plate temperature is supplied manually by an operator of the printing press 10.

The operation of the invention will now be described. When the press 10 is initially started, the cylinders 12 and the rollers 30 may be such that the plate temperature is lower than desired. Under these circumstances, the control unit 82 activates the second circulating pump 78 and the water heater 42. The unit 82 also energizes the mixing valve 70 so that water is circulated through the heater 42, the pipe 44, the branch pipe 74, and the pipe 76 to the second circulating pump 78 to supply heated water to the conduit 36 for circulation through the hollow ink rollers 30.

As the plate temperature rises due both to heat supplied by the unit 40 and also due to frictionally generated heat occurring during operation of the press 10, cooling of the printing plate 14 becomes necessary to maintain the desired inking temperature. In the cooling mode of the unit 40, the heater 42 is turned off while the chiller 50 is activated to maintain a supply of cooled water in the outlet chamber 58. The mixing valve 70, under control of the control unit 82, regulates the temperature of the water supplied to the inking rollers 30 through the conduit 36 by proportioning the amount of cooled water from the chamber 58 with the amount of warm water returning from the rollers 30 through the conduit 38 and the branch pipe 74. By way of example, if a plate temperature of 60° F. is desired, the temperature of the water supplied is about 48° F. as will be apparent to those skilled in the art, the temperatures are dependent on several factors, including the speed of the operating press 10 and the amount of ink coverage.

While, in the illustrated embodiment, the cooling-/heating unit 40 is an integrated unit, it may be preferable to have the reservoir 48 and the water chiller 50 located separately from the remainder of the unit 40. The space available for installation, as well as other factors, determine the particular configuration.

As these and other changes may be made in the described embodiment of the invention without departing from the spirit thereof, reference should be had to the appended claims in determining the true scope of the invention.

What is claimed is:

1. A temperature control system for a printing plate of a rotary press of a type having a cylinder, said printing plate being carried on the cylinder, and an ink train including a plurality of ink rollers, at least one of which rollers is hollow and equipped with connections for circulating water in a heat exchange relationship therethrough, said system comprising:

a water circulating unit including a two-chambered water reservoir, two circulating pumps, a water chiller, a water heater and a controllable mixing valve, said circulating unit being connected to the hollow roller to provide a closed loop water circulating path;

temperature sensing means for detecting a temperature of the printing plate and also for generating a signal corresponding to a detected plate temperature; and

means, responsive to the signal, for controlling the circulating unit so as to regulate a temperature of the water circulating through the closed loop path in accordance with the detected plate temperature.

2. The temperature control system of claim 1 wherein said temperature sensing means comprises an infrared temperature sensor mounted in close proximity to the cylinder.

3. A temperature control system for a printing plate of a rotary press of a type having a cylinder, said printing plate being carried on the cylinder, and an ink train including a plurality of ink rollers, at least one of which rollers is hollow and equipped with connections for circulating water in a heat exchange relationship therethrough, said system comprising:

a water circulating unit including a circulating pump, a water chiller, and a controllable mixing valve, said circulating unit being connected to the hollow roller to provide a closed loop water circulating path;

temperature sensing means for detecting a temperature of the printing plate and also for generating a signal corresponding to a detected plate temperature; and

means, responsive to the signal, for controlling the circulating unit so as to regulate a temperature of the water circulating through the closed loop path in accordance with the detected plate temperature;

wherein said temperature sensing means comprises an infrared temperature sensor mounted in close proximity to the cylinder;

wherein the circulating unit further includes a water heater; and

wherein the circulating unit further includes a reservoir having a first chamber receiving water returned from the roller and also having a second chamber, said water chiller being connected between the first chamber and the second chamber, said mixing valve having a first inlet connected to the second chamber for receiving cooled water therefrom and also having a second inlet for receiving water returned from the roller, said mixing valve being operable to proportion water flow through the first inlet and the second inlet in accordance with a desired water temperature.

4. A temperature control system for a printing plate of a rotary press of a type having a cylinder, said printing plate being carried on the cylinder, and an ink train including a plurality of ink rollers, at least one of which rollers is hollow and equipped with connections for circulating water in a heat exchange relationship therethrough, said system comprising:

a water circulating unit including a circulating pump, a water chiller, and a controllable mixing valve, said circulating unit being connected to the hollow roller to provide a closed loop water circulating path;

temperature sensing means for detecting a temperature of the printing plate and also for generating a signal corresponding to a detected plate temperature; and

means, responsive to the signal, for controlling the circulating unit so as to regulate a temperature of the water circulating through the closed loop path in accordance with the detected plate temperature;

wherein the circulating unit further includes a water heater; and

wherein the circulating unit further includes a reservoir having a first chamber receiving water returned from the roller and also having a second chamber, said water chiller being connected between the first chamber and the second chamber, said mixing valve having a first inlet connected to the second chamber for receiving cooled water therefrom and also having as second inlet for receiving water returned from the roller, said mixing valve being operable to proportion water flow through the first inlet and the second inlet in accordance with a desired water temperature.

5. A temperature control system for a printing plate of a rotary press of a type having a cylinder, said printing plate being carried on the cylinder, and an ink train including a plurality of ink rollers, at least one of which rollers is hollow and equipped with connections for circulating water in a heat exchange relationship therethrough, said system comprising:

a water circulating unit including a circulating pump, a water chiller, and a controllable mixing valve, said circulating unit being connected to the hollow roller to provide a closed loop water circulating path;

temperature sensing means for detecting a temperature of the printing plate and also for generating a signal corresponding to a detected plate temperature; and

means, responsive to the signal, for controlling the circulating unit so as to regulate a temperature of the water circulating through the closed loop path in accordance with the detected plate temperature;

wherein the circulating unit further includes a reservoir having a first chamber receiving water returned from the roller and also having a second chamber, said water chiller being connected between the first chamber and the second chamber, said mixing valve having a first inlet connected to the second chamber for receiving cooled water therefrom and also having a second inlet for receiving water returned from the roller, said mixing valve being operable to proportion water flow through the first inlet and the second inlet in accordance with a desired water temperature.

6. A method of controlling a temperature of a printing plate of a rotary press of a type having a cylinder, said printing plate being carried on the cylinder, said rotary press having an ink train with a plurality of ink rollers, at least one of which is hollow and equipped with connections for circulating water in a heat exchange relationship therethrough, said method comprising the steps of:

pumping circulating water in a closed loop path from a two-chambered water reservoir to a controllable mixing valve through at least one hollow roller and back to the water reservoir;

measuring the temperature of the printing plate via a sensor;

generating from the sensor a signal corresponding to a measured plate temperature; and

controlling temperature of the circulating water via a water heater and a water chiller in response to the signal corresponding to the measured plate temperature.

7. A temperature control system for a printing plate of a rotary press of a type having a cylinder, said printing plate being carried on the cylinder, and an ink train including a plurality of ink rollers, at least one of which rollers is hollow and equipped with connections for circulating water in a heat exchange relationship therethrough, said system comprising:

a water circulating unit including a two-chambered water reservoir, two circulating pumps, a water chiller, a water heater, and a controllable mixing valve, said circulating unit being connected to the hollow roller to provide a closed loop water circulating path;

temperature sensing means for detecting a temperature at a selected point of the rotary press and also for generating a signal corresponding to a detected temperature at the selected point; and

means, responsive to the signal, for controlling the circulating unit so as to regulate a temperature of the water circulating through the closed loop path in accordance with the detected temperature at the selected point.

8. A method of controlling a temperature of a printing plate of a rotary press of a type having a cylinder, said printing plate being carried on the cylinder, said rotary press having an ink train with a plurality of ink rollers, at least one of which is hollow and equipped with connections for circulating water in a heat exchange relationship therethrough, said method comprising the steps of:

pumping circulating water in a closed loop path from a two-chambered water reservoir to a controllable mixing valve through at least one hollow roller and back to the water reservoir;

measuring the temperature at a selected point of the rotary press via a sensor;

generating from the sensor a signal corresponding to a measured temperature at the selected point; and

controlling temperature of the circulating water via a water heater and a water chiller in response to the signal corresponding to the measured temperature at the selected point.

* * * * *

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United States Patent [19]

Herbert et al.

[11] Patent Number: 5,209,179

[45] Date of Patent: May 11, 1993

[54] LIQUID COATING APPARATUS FOR USE IN CONJUNCTION WITH PRINTING PRESSES WHERE ACCESS OF THE COATING APPARATUS TO THE PRESS CYLINDERS IS RESTRICTED

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[21] Appl. No.: 709,750

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[51] Int. Cl.[5] B05C 1/02

[52] U.S. Cl. 118/46; 118/249; 118/257; 118/231; 101/DIG. 48

[58] Field of Search .... 118/46, 211, 219, 221, 118/231, 249, 257; 101/DIG. 33, DIG. 48

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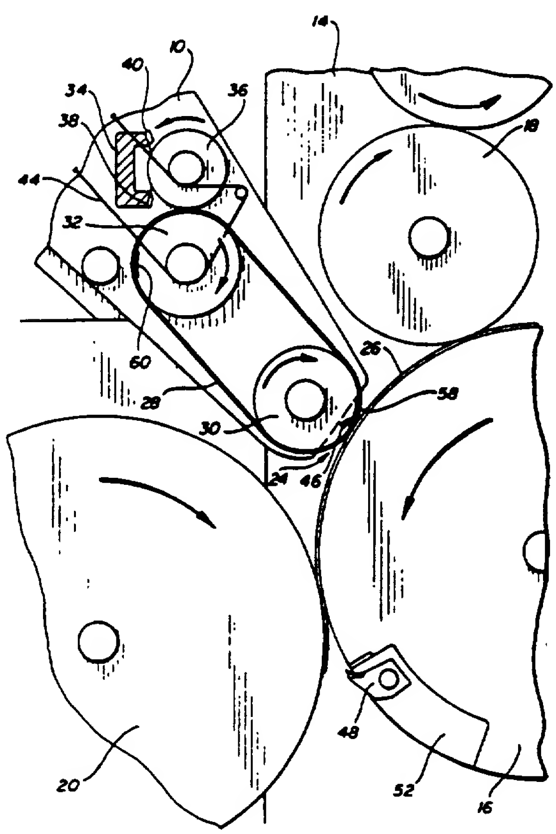
Assistant Examiner—Todd J. Burns

Attorney, Agent, or Firm—Hoffmann & Baron

[57] ABSTRACT

A liquid coating apparatus capable of applying a liquid coating fluid to a workpiece traveling over a press cylinder rotatably mounted in a printing press is provided. The coating apparatus includes an applicator means which communicates with the press cylinder to form a nip site when the coating apparatus is in a operative position. The applicator means transfers the liquid coating fluid from the coating apparatus to a workpiece that has been caused to travel through the nip site. The applicator means includes an endless coating plate belt driveably mounted upon two support rollers, thereby affording communication of the endless coating plate belt with a press cylinder which has limited access to its surface.

16 Claims, 4 Drawing Sheets



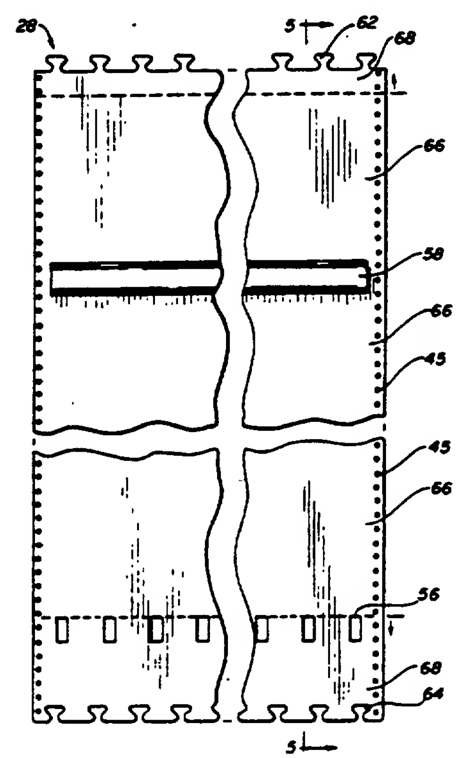


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FIG-1

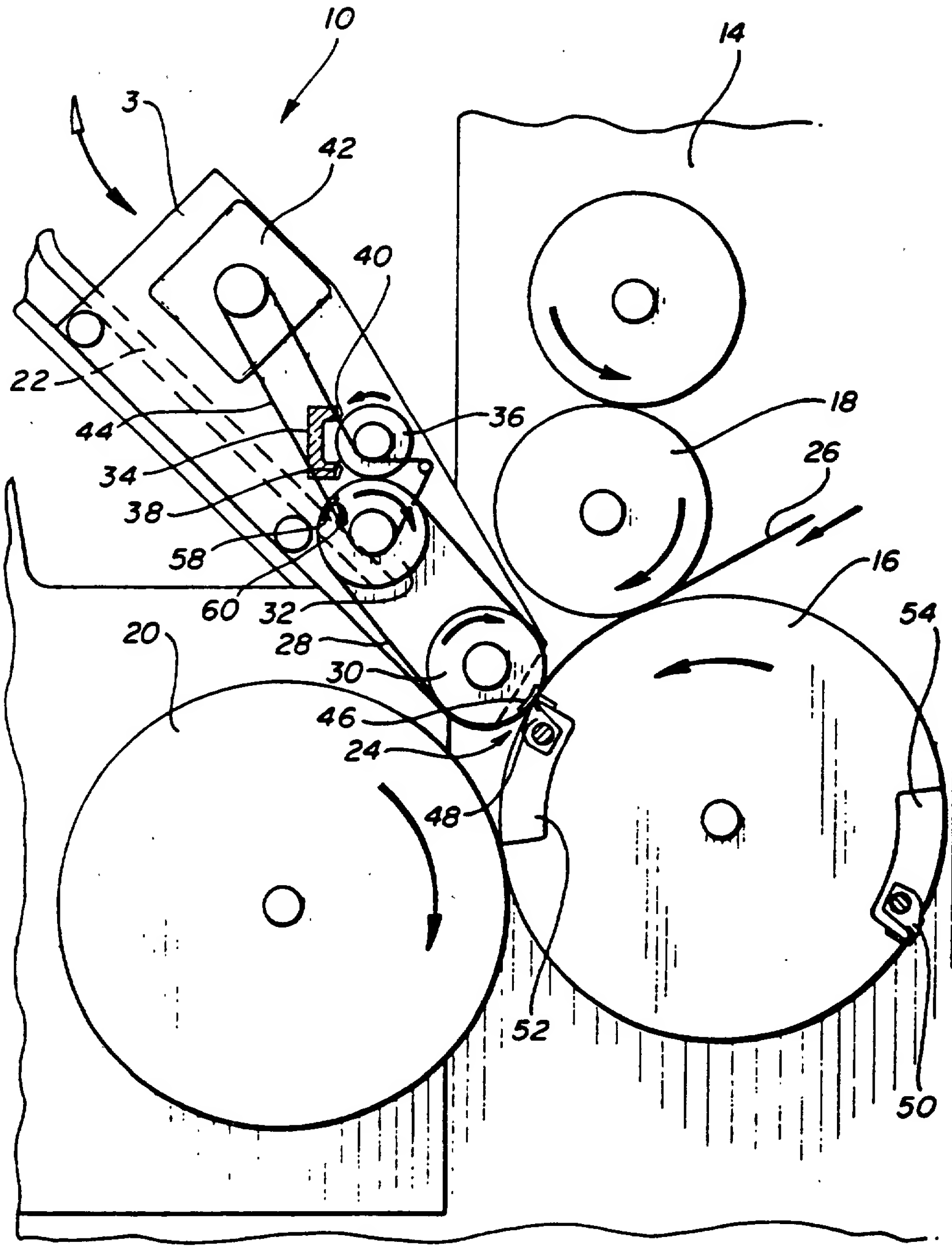


FIG-2

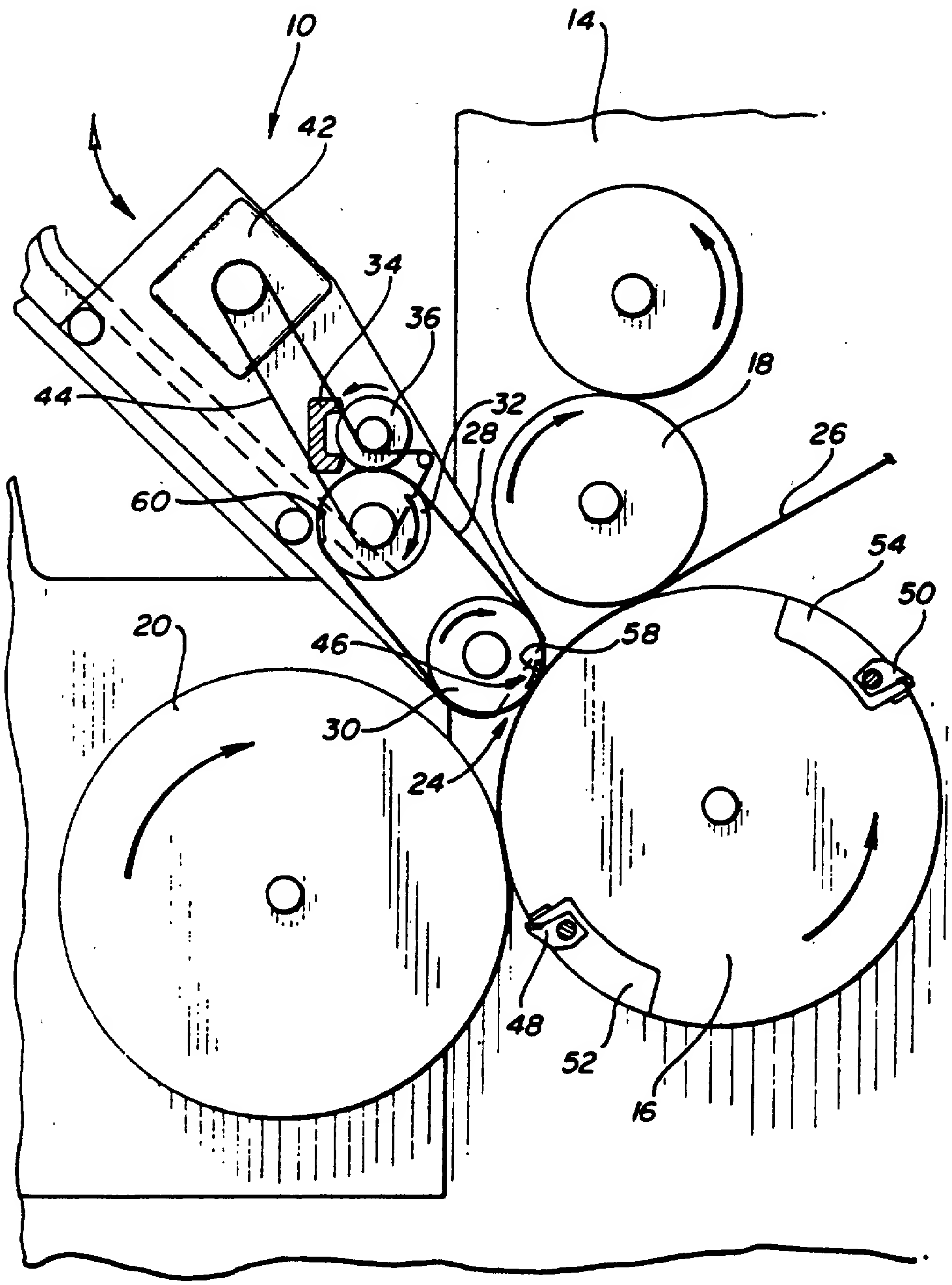


FIG-3

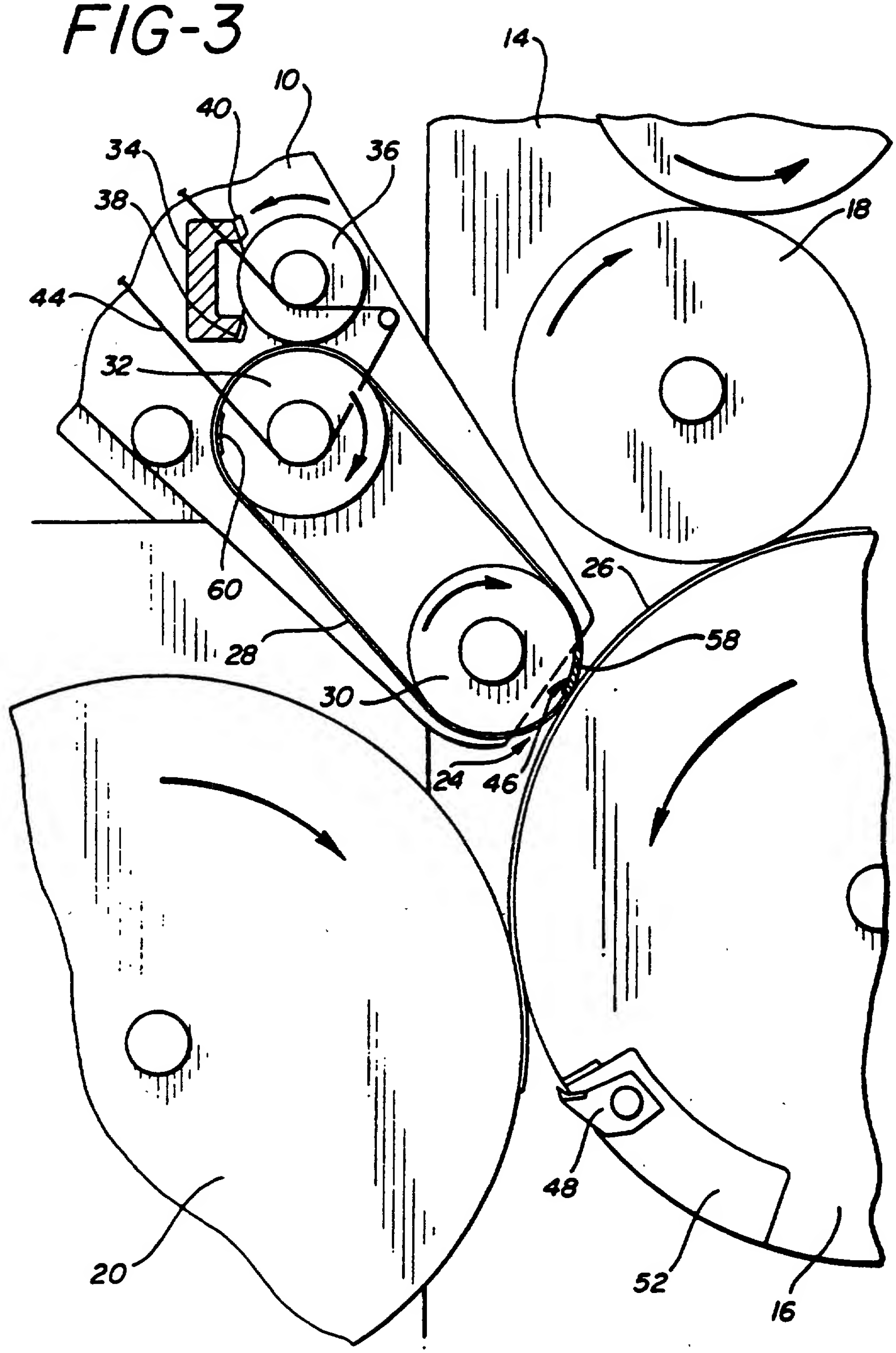


FIG-4

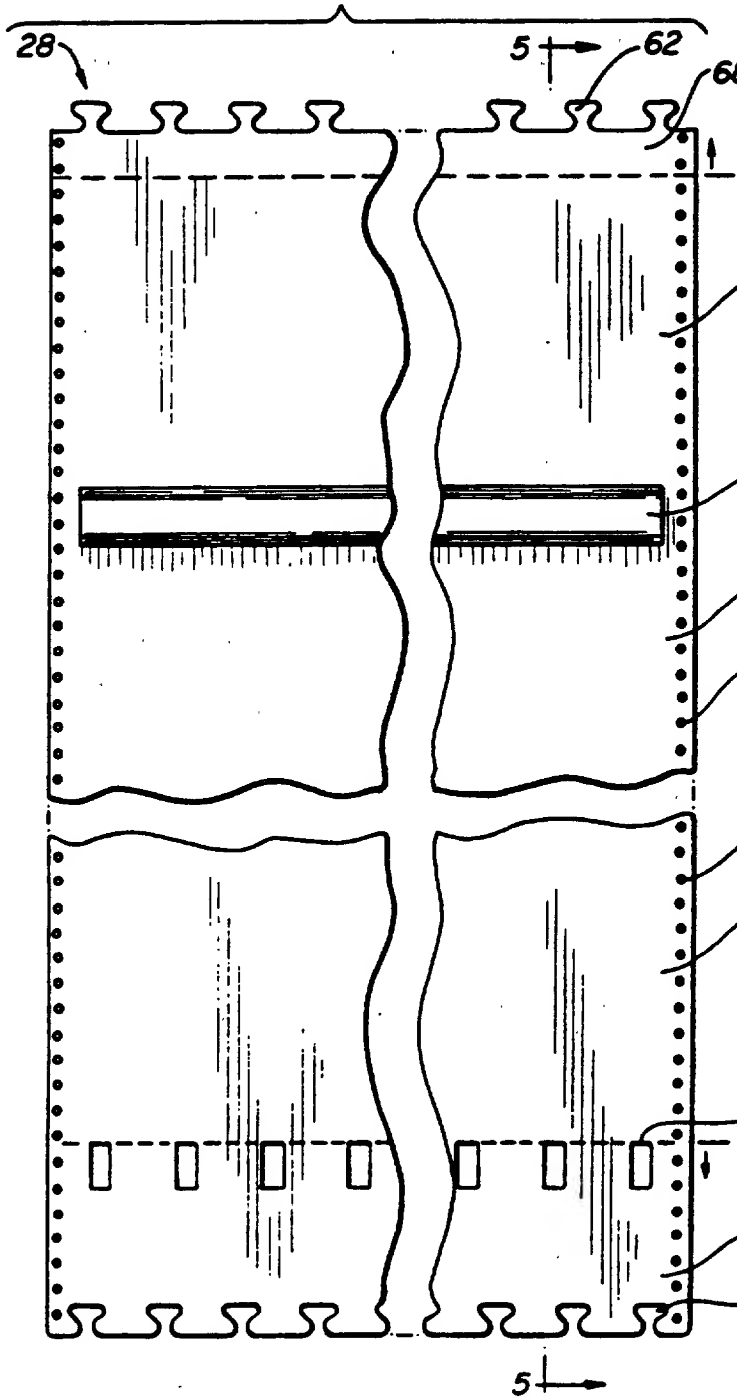
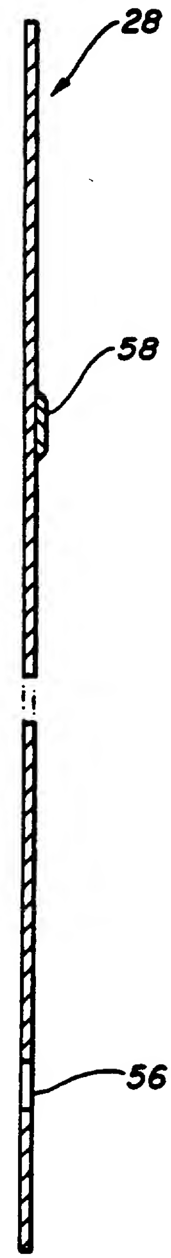


FIG-5



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LIQUID COATING APPARATUS FOR USE IN CONJUNCTION WITH PRINTING PRESSES WHERE ACCESS OF THE COATING APPARATUS TO THE PRESS CYLINDERS IS RESTRICTED

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the printing industry and in particular to coating apparatus used in conjunction with printing presses for the application of liquid coating fluid to the surface of a workpiece. In particular, the present invention relates to coating apparatus which apply a liquid coating fluid to a workpiece while the workpiece travels over a press cylinder rotating in a printing press. More particularly, the present invention relates to coating apparatus for applying a liquid coating fluid to a workpiece on a press cylinder where access to the surface of the cylinder is restricted due to the orientation of adjacent cylinders operating in the printing press.

2. Description of the Prior Art

In many situations in the printing industry, it is desirable to apply a liquid coating fluid to the surface of a workpiece as it travels through a printing press. In order to achieve this objective, it is necessary to position a coating apparatus in sufficient proximity to the printing press so that the applicator means of the coating apparatus can contact the workpiece and apply the coating fluid as the workpiece moves over one of the press cylinders. Once the applicator means comes in contact with the press cylinder, a "nip" is formed through which the workpiece can travel.

In the printing industry, there are several types of printing presses having press cylinders which are oriented within the press frame in such a manner that access to their surface is limited. Consequently, problems have arisen when artisans have attempted to position a coating apparatus within sufficient proximity to the printing press so that the applicator means of the coating apparatus can form a "nip" with a particular press cylinder in the press.

These problems are mostly due to spacial constraints imposed by other press cylinders which are adjacent to the particular press cylinder sought to be contacted. For example, in one commercially available printing press (manufactured by the Komori Corporation, Tokyo, Japan), the impression cylinder is positioned between a blanket cylinder and a delivery or transfer cylinder in a configuration that severely restricts access to the surface of the impression cylinder. Consequently, existing coating assemblies cannot be used with such presses where contact with the impression cylinder is desired since the diameter of the applicator roller of these assemblies is too large to clear the space between the blanket cylinder and the delivery or transfer cylinder.

It is therefore an object of the present invention to provide for a coating apparatus which can be used in conjunction with a printing press to apply a liquid coating fluid to a workpiece traveling on a press cylinder having restricted access to its surface.

SUMMARY OF THE INVENTION

The present invention is a liquid coating apparatus operable in conjunction with either a sheet-fed or a web-fed printing press and is capable of applying a liquid coating fluid to a workpiece while the workpiece travels over the surface of a press cylinder rotating within the press. The present invention is especially advantageous when attempting to apply coating fluid to a workpiece traveling upon a press cylinder having restricted access to its surface.

The coating apparatus of the present invention includes a driveable support means capable of supporting an endless coating plate belt which functions to transfer liquid coating fluid from the coating apparatus to the workpiece. The coating plate belt is both supported and driven by the driveable support means. The coating apparatus also includes means for driving the driveable support means such that the coating plate belt is caused to be driven about the support means. A supply means is included to supply the liquid coating fluid to the belt while a metering means is employed to meter the supply of liquid coating fluid being supplied to the belt.

For a better understanding of the present invention, together with other and further objects, reference is made to the following description, taken together with the accompanying drawings and its scope will be pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of the coating apparatus of the present invention shown in communication with a sheet-fed printing press.

FIG. 2 is a side elevational view of the coating apparatus of FIG. 1 wherein the coating plate belt is shown at a different point in its rotation about the driveable support means.

FIG. 3 is a side elevational view of the coating apparatus shown in FIG. 2 enlarged to show the nip site present between the coating apparatus and the printing press.

FIG. 4 is a plan view of the coating plate belt of the present invention shown from the backside of the belt.

FIG. 5 is a side elevational view of the coating plate belt of FIG. 4.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Referring to FIGS. 1–4, the preferred embodiment of a coating apparatus 10 of the present invention is provided. Referring to FIG. 1, the coating apparatus 10 is shown positioned adjacent to a printing press 14. The printing press 14 includes a printing press cylinder 16 which is typically either a blanket or an impression cylinder. Press cylinder 16 has limited access to its surface due to adjacent press cylinders 18 and 20.

Retraction means 22 is provided for moving the coating apparatus into and out of an adjoining relationship with press cylinder 22 at nip site 24. In the operative position, the coating apparatus forms a "nip" with press cylinder 16 through which a workpiece 26 may pass.

Coating apparatus 10 includes an endless coating plate belt 28 which is supported by and trained about a first roller 30 and a second roller 32, both mounted for rotation within coating apparatus frame 33.

The coating belt 28 delivers liquid coating fluid to workpiece 26 as the workpiece travels through nip site 24 mounted about cylinder 16. Coating fountain 34 supplies liquid coating fluid to anilox roller 36 which, in turn, transfers the coating fluid from the fountain to coating belt 28. Doctor blades 38 and 40 are coupled to coating fountain 34 to meter the supply of coating fluid

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transferred to coating belt 28 via anilox roller 36. The liquid coating supply means can be of any suitable type known in the art. Additionally, other methods known in the art for transferring and metering the coating supply to be received by coating belt 28 could alternatively be employed. The combination of an anilox roller and a doctor blade is merely exemplary of one such approach.

As previously mentioned, a first roller 30 and a second roller 32 provide support for coating plate belt 28. Roller 30 is referred to as a pressure roller since it provides the coating plate belt 28 with support at nip site 24, thereby affording sufficient "back pressure" against workpiece 26 as it moves through the nip. Roller 32 is referred to as a transfer roller since it provides the coating belt with support at the point where the coating belt receives coating fluid that has been transferred by anilox roller 36.

Coating plate belt 28 is trained around the pressure and transfer rollers for movement about the rollers. At least one of the rollers is driveably coupled to a motor or some other drive means. In the preferred embodiment of the present invention, transfer roller 32 is driveably coupled to motor 42 by way of drive train belt 44 enabling transfer roller 32 to undergo rotation upon activation of motor 42. Coating belt 28 is driveably coupled to transfer roller 32 such that rotation of the roller drives the coating belt about both pressure roller 30 and transfer roller 32.

In the preferred embodiment of the present invention, pressure roller 30 is not coupled to drive train belt 44, but rather rotates via a drive coupling (not shown) with coating plate belt 28. This drive coupling can be of any suitable type known in the art. For example, FIG. 4 shows coating plate belt 28 having track holes 45. These track holes communicate with sprocket assemblies (not shown) on rollers 30 and 32.

Referring to FIGS. 1–4, transfer roller 32 undergoes rotation via drive train belt 44. A sprocket assembly (not shown) coupled to transfer roller 32 rotates engaging track holes 45 on coating plate belt 28, thereby imparting movement to the coating belt. Consequently, coating plate belt 28 undergoes movement and imparts rotation to pressure roller 30 upon communication of track holes 45 with a sprocket assembly (not shown) coupled to roller 30. Alternatively, drive train belt 44 can be driveably coupled to pressure roller 30, leaving transfer roller 32 to undergo rotation via movement of coating belt 28.

Another drive train configuration (not shown) can also be employed utilizing an auxiliary drive coupling between transfer roller 32 and pressure roller 30. In this configuration, drive train belt 44 is operatively coupled to one of the rollers at one side while the auxiliary drive coupling is coupled to the other side. The auxiliary drive coupling is also coupled to the other roller, thereby imparting rotation to the other roller and alleviating drive stress on the coating plate belt 28.

In the preferred embodiment of the present invention, the rollers of the coating apparatus are driven by an independent drive means, such as motor 42. Alternatively, the rollers of the coating apparatus could be driven by a positive coupling to the printing press drive train, thereby avoiding the need for an independent motor assembly.

Although the present invention is capable of applying liquid coating fluid to a workpiece traveling over a press cylinder in either a web-fed or an individual sheet-fed press, the preferred embodiment shown in FIGS. 1–4 includes structure for operation in conjunction with the latter.

In particular, pressure roller 30 includes a notch or recessed area 46 formed or cut into its surface as shown in FIGS. 1-3. Recessed area 46 should have sufficient dimensions to accommodate the height of gripper 48 and gripper 50 as they pass through the nip site 24.

In sheet-fed printing presses, individual workpieces travel through the press, one sheet at a time. Consequently, press cylinders employed in these presses have "grippers" positioned at various points along their surfaces in order to transfer and guide the individual sheets from cylinder to cylinder. Generally, grippers function by grabbing and retaining the leading edge of an individual sheet until the sheet is subsequently passed to an adjacent cylinder. Each gripper has a series of finger-like projections extending outwardly from and positioned longitudinally along the body of the gripper to perform the "grabbing" and "retaining" function.

A gripper is typically positioned in a cylinder gap or trough so that it does not create an obstruction when the cylinder rotates the gripper into contact with an adjacent cylinder. For example, in FIGS. 1-3, grippers 48 and 50 are shown residing in cylinder gaps 52 and 54, respectively. Although most of the gripper body resides in the recessed cylinder gap, a portion of the gripper fingers extending from each gripper must protrude slightly above the surface of the cylinder on which the gripper is positioned in order to effectively "grab" the leading edge of the sheet. Consequently, there must be a notch or recessed area residing somewhere along a portion of the surface of any cylinder which abuts another cylinder having a gripper. This notch or recessed area must be of sufficient depth to accommodate that portion of the gripper protruding above the surface of the cylinder on which it resides

Generally, impression and transfer cylinders of sheet-fed printing presses are equipped with grippers while any blanket and/or other cylinders which abut impression or other cylinders having grippers include recessed areas in their surfaces to accommodate the grippers.

Referring to FIGS. 1-3, coating plate belt 28 is shown passing between pressure roller 30 and press cylinder 16 in order to transfer the liquid coating fluid to workpiece 26 as it passes through the nip site 24. Referring briefly to FIG. 4, coating plate belt 28 includes gripper slots 56 formed through the thickness of the belt and positioned across the width of the belt. When coating belt 28 is initially mounted about rollers 30 and 32, it should be oriented so as to align the gripper slots 56 over the recessed area 46 of the pressure roller 30.

Furthermore, the orientation of the coating plate belt about rollers 30 and 32 should be such that the gripper slots 56 are aligned over recessed area 46 at a preselected angular rotational position of pressure roller 30. More particularly, gripper slots 56 should pass through nip site 24 simultaneously and in alignment with recessed area 46 so as to accommodate the height of grippers 48 and 50. Consequently, gripper slots 56 should be of sufficient number and should have dimensions for accommodating the gripper-fingers (not shown) of grippers 48 and 50. Insufficient slot size or misalignment of the slots and recessed area 46 may damage the coating plate belt or the grippers.

In addition to providing for an alignment of gripper slots 56 with recessed area 46 on pressure roller 30 in order to accommodate any grippers which may be pres-

ent on press cylinder 16, coating plate belt 28 must be sized in accordance with the press cylinder to which it abuts to form a nip when the coating apparatus is being used in conjunction with a sheet-fed press or during spot-coating operations performed on either a sheet-fed or web-fed press.

For example, in a sheet-fed printing press, individual sheets are transferred from press cylinder to press cylinder as they move through the press. As previously mentioned, these individual sheets or workpieces are often retained on the surface of these cylinders by grippers which grab the leading edge of the workpiece. The number of sheets that can be retained on the surface of any one cylinder at any one instant in time depends upon the number of grippers available on the cylinder, the circumferential diameter available on the cylinder surface against which the sheets are supported and the length of the individual sheets. Cylinder gaps recessed in the surface of these cylinders for housing the grippers do not provide for a supporting surface against which a workpiece can rest and consequently result in what is referred to as "dead space" on the cylinder surface.

For example, the area of a press cylinder surface between the trailing edge of one workpiece and the leading edge of another workpiece would constitute "dead space". Obviously, in coating operations where the coating apparatus is contacting a press cylinder to deliver coating fluid to a workpiece, it would be undesirable to have the coating plate belt deliver coating fluid to the nip when there is no workpiece present to receive the coating fluid.

Consequently, when the coating apparatus of the present invention is used in conjunction with a sheet-fed printing press or in spot coating operations, the coating plate belt must be sized in order to accommodate individual sheet length as well as individual sheet width. Additionally, the belt length must also include "no print" areas where coating fluid is absent from the belt. These "no print" areas must be coordinated with "dead space" present on the press cylinder.

Accordingly, the length of the coating plate belt of the present invention is either equivalent to or an inverse multiple of the circumferential measurement of the press cylinder to which it abuts. For example, in the preferred embodiment of the present invention, coating plate belt 28 has a length which is one half the circumferential measurement of press cylinder 16. Consequently, for every complete rotation of press cylinder 16, coating belt 28 makes two complete revolutions around rollers 30 and 32.

Alternatively, in overall coating or full-coverage coating operations performed on a web-fed press, a continuous web of material receives a uniform, unbroken application of coating fluid. Consequently, if the present invention were to be employed in such a procedure, considerations regarding belt length and the strategic positioning of "no print" regions along the length of the belt would be of minor concern.

Referring to FIG. 1, workpiece 26 is shown with its leading edge held in position at nip site 24 by gripper 48. Recessed area 46 is present at the nip site to accommodate the portion of gripper 48 which extends above the surface of press cylinder 16. As previously mentioned, it is necessary to have the recessed area 46 positioned in the nip site simultaneously with the gripper in order to prevent damage to the equipment.

Additionally, the circumferential measurement of pressure roller 30 must be an inverse multiple of the circumferential measurement of press cylinder 16. By way of illustration, if pressure roller 30 has a circumferential measurement equivalent to the circumferential measurement of press cylinder 16, pressure roller 30 would require a number of recessed areas on its surface equal to the number of grippers on press cylinder 16. Furthermore, each of the recessed areas must be of sufficient depth to accommodate that portion of each gripper finger which extends from the body of each gripper and protrudes above the press cylinder surface.

Such a situation would be impossible however, due to the presence of press cylinders 18 and 20, which severely limit accessibility to the surface of press cylinder 16. Consequently, the circumferential measurement of pressure roller 30 cannot be equivalent to the circumferential measurement of press cylinder 16, but rather must be sufficiently reduced in order to access the cylinder surface.

Since pressure roller 30 will have a smaller circumferential measurement than press cylinder 16, it will rotate a number of times for every single rotation of press cylinder 16 in order to maintain the same surface speed. If press cylinder 16 has grippers present on its surface, pressure roller 30 will have to have a circumferential measurement which is an inverse multiple of the circumferential measurement of press cylinder 16 in order to have recessed area 46 present at nip site 24 when a gripper passes through the nip.

In a typical coating apparatus used in conjunction with a sheet-fed printing press, an applicator roller on the coater transfers the coating fluid to the printing press. In particular, the applicator roller either transfers the coating fluid directly to the workpiece as it moves through the nip site created between a printing press cylinder and the coating apparatus applicator roller or the applicator roller transfers the coating fluid to a blanket cylinder which, in turn, applies the coating fluid to the workpiece.

In either situation, the applicator roller will repeatedly apply coating fluid directly or indirectly to individual worksheets as they pass through the nip. Consequently, the applicator roller must have a circumferential measurement at least equivalent to sheet length in order to ensure image repeatability. Furthermore, the circumferential measurement of the applicator roller must actually be greater than the individual sheet length so that the "dead space" present on the press cylinder surface between the trailing edge of one sheet and the leading edge of the next sheet does not receive any coating fluid.

Due to the spacial constraints present in many printing press arrangements, a coating apparatus having an applicator roller conforming to even these minimal circumferential measurement parameters has a diameter which precludes it from abutting the desired press cylinder within the printing press in order to deliver a liquid coating fluid to a workpiece traveling thereon.

Consequently, in the preferred embodiment of the present invention, the coating plate belt 28 should be of sufficient length to accommodate a coating surface equivalent to the individual sheet length of workpiece 26 plus any additional length needed to provide for a "no print" region corresponding to the "dead space" on the press cylinder.

In short, the length of coating plate belt 28 should be proportional to the circumferential measurement of press cylinder 16. As previously mentioned, these considerations apply when the present invention is being

used in conjunction with a sheet-fed press or in a spot coating procedure done on either a sheet-fed or web-fed press. For spot coating procedures performed on a web-fed press, the belt length must be sized so as to incorporate "no print" regions despite the fact that no grippers or cylinder gaps are present. In contrast, overall coating procedures performed on a web-fed press do not require that the length of the coating plate belt be sized to account for the presence of "no print" regions since the coating fluid is continuously being applied.

The diameter of pressure roller 30 should be sufficiently reduced so as to afford clearance between press cylinders 18 and 20 while providing for contact of the coating belt with press cylinder 16. As previously mentioned, the circumferential measurement of pressure roller 30 should be an inverse multiple of the circumferential measurement of press cylinder 16 in order to ensure that the recessed area 46 is always present at the nip site whenever a gripper on press cylinder 16 passes through the nip.

In the preferred embodiment of the present invention, pressure roller 30 has, for example, a circumferential measurement which is ¼ the circumferential measurement of press cylinder 16. Consequently, for every complete rotation of press cylinder 16, pressure roller 30 makes four complete revolutions. Furthermore, recessed area 46 passes through nip site 24 four times, twice for every passage of a gripper through the nip. As a result, recessed area 46 only accommodates a gripper at nip site 24 during every other passage through the nip.

For example, referring to FIGS. 2 and 3, recessed area 46 is shown in a position just prior to entering nip site 24. Referring in particular to FIG. 2, grippers 48 and 50 are shown in their respective positions approximately 90° away from the nip site.

As previously explained, coating plate belt 28 must be of a length proportional to the circumferential measurement of press cylinder 16 and pressure roller 30 must be an inverse multiple of the circumferential measurement of press cylinder 16. Consequently, the length of coating plate belt 28 will be proportional to the circumferential measurement of pressure roller 30, by necessity.

This relationship is important. During every other passage of recessed area 46 through nip site 24, coating plate belt 28 is applying coating fluid to workpiece 26, as seen in FIG. 3. In order for the coating fluid to be uniformly applied to the surface of the workpiece, pressure roller 30 must apply sufficient back pressure to coating belt 28 at nip site 24.

In order to maintain this back pressure on the coating belt at the nip site during every other passage of recessed area 46 through the nip, a filler piece or strip 58 is mounted across the width of the coating belt as seen in FIG. 4. The filler piece is mounted on the backside of the coating belt which contacts rollers 30 and 32. Filler piece 58 should have dimensions approximating the dimensions of recessed area 46 so as to cooperatively mate with the recess. Similarly, recessed area 46 should have dimensions which can accommodate filler piece 58.

As previously explained with respect to the preferred embodiment of the present invention, press cylinder 16 makes one complete revolution for every four complete revolutions of pressure roller 30. Furthermore, recessed area 46 will pass through the nip site four times for every complete revolution of press cylinder 16. In two of these passes through the nip site, a gripper on press cylinder 16 will be present at the nip to meet the recessed area. In the other two passes through the nip site, no gripper will be present to meet the recessed area, however, the filler piece on the backside of the coating belt will move into recessed area to provide back pressure for the coating belt which is simultaneously delivering coating fluid to the workpiece in the nip.

Since the filler piece 58 is affixed to the backside of coating plate belt 28, its presence must be accommodated on transfer roller 32 as well. Consequently, transfer roller 32 has a secondary recessed area 60 on its surface. Secondary recessed area 60 also has dimensions which approximate the dimensions of filler piece 58 so as to accommodate the presence of the filler piece when it contacts the roller surface.

Referring to FIG. 4, coating plate belt 28 is shown in a plan view from the backside of the belt. The coating plate belt includes splicing patterns 62 and 64 which consists of cooperating mechanical segments which can interlock with one another in order to position the belt about rollers 30 and 32. The coating plate belt includes printing region 66 and no print region 68. Printing region 66 is available for delivering coating fluid to a workpiece as it passes through the nip site. Accordingly, coating plate belt 28 must be oriented about rollers 30 and 32 in such a fashion as to coordinate the passage of printing region 66 through the nip site with those areas on the surface of press cylinder 16 which do not constitute "dead space". No print region 68 includes gripper slots 56. This region of coating plate belt 28 must similarly be coordinated with the surface of press cylinder 16, however, it should be coordinated so as to pass through the nip site simultaneously with the "dead space" (not shown) present on press cylinder 16.

The coating plate belt of the present invention is interchangeable with other coating belts depending upon the coating operation to be performed. In overall coating operations where the workpiece receives full coverage of the coating fluid, the coating plate belt need only be changed depending upon the dimensions of the workpiece to be covered or the type of coating fluid to be applied. In spot coating operations, however, the coating plate belt should obviously be changed in accordance with designated areas on the workpiece which are to receive the coating fluid.

In operation, anilox roller 36 picks up coating fluid from coating fountain 34. Doctor blades 38 and 40 meter the supply of coating fluid on the anilox roller before the fluid is transferred to coating plate belt 28. Anilox roller 36 subsequently transfers the metered supply of coating fluid to coating plate belt 28 which is driven about rollers 30 and 32. Referring to FIG. 1, a workpiece 26 is shown partially positioned on press cylinder 16 with its leading edge held by gripper 48. Recessed area 46 is present to accommodate gripper 48 and the no print region 68 (not shown) of the belt is present in nip site 24 to correspond with the presence of "dead space" (not shown) on press cylinder 16. Filler piece 58 is shown positioned in contact with transfer roller 32 and residing in secondary recessed area 60.

As the workpiece moves through the nip, printing region 66 (not shown) of plate coating belt 28 applies the coating fluid to workpiece 26 at the nip site. Referring to FIG. 3, workpiece 26 is shown positioned well into the nip. Additionally, recessed area 46 on pressure roller 30 is about to enter the nip site 24. Filler piece 58 is shown residing in recessed area 46 in order to provide sufficient back pressure for coating plate belt 28 which

is applying coating fluid (not shown) to the workpiece. Secondary recessed area 60 on transfer cylinder 32 is shown vacant as filler piece 58 is residing in recessed area 46.

While there have been described what are presently believed to be the preferred embodiments of the invention disclosed herein, those skilled in the art will realize that changes and modifications may be made thereto without departing from spirit of the invention, and it is intended to claim all such changes and modifications as fall within the true scope of the invention.

What is claimed is:

1. A liquid coating apparatus capable of operating in conjunction with a printing press having at least one press cylinder, the cylinder rotatably mounted within the press and having at least one gripper mechanism, the apparatus capable of applying a liquid coating fluid to a workpiece traveling over the press cylinder and comprising:

a driveable support means suitable for supporting a belt, the support means including a first and a second roller both rotatably mounted within the apparatus, at least one of the rollers being drivingly coupled to a drive means;

an endless coating plate belt for transferring the liquid coating fluid from the coating apparatus to the workpiece, the endless coating plate being trained about the first and second rollers and driveable by the rollers and supported thereon, the belt including at least three openings distributed transversely across the width of the belt;

drive means for driving the support means, thereby causing the endless coating plate belt to be driven about the first and second rollers;

supply means for supplying the liquid coating fluid to the endless coating plate belt; and

metering means for metering the supply of liquid coating fluid supplied to the endless coating plate belt.

2. The liquid coating apparatus according to claim 1, wherein the first roller includes at least one recessed area present on the surface of the first roller and wherein the at least three openings are gripper slots formed through the thickness of the endless coating plate belt, the gripper slots being positionally aligned over the recessed area on the surface of the first roller at a selected angular rotational position of the first roller.

3. The liquid coating apparatus according to claim 2, wherein the endless coating plate belt includes a filler piece having dimensions approximating the dimensions of the recessed area on the surface of the first roller, the filler piece being oriented on the endless coating plate belt so as to afford a cooperative communication of the filler piece with the recessed area on the surface of the first roller upon contact of the filler piece with the first roller and wherein the second roller includes a recessed area on its surface having suitable dimensions for accommodation of the filler piece in a cooperative relationship upon contact of the filler piece with the second roller.

4. The liquid coating apparatus according to claim 2, wherein the first roller has a circumferential measurement which is an inverse multiple of the circumferential measurement of the press cylinder.

5. The liquid coating apparatus according to claim 4, wherein the first roller has a circumferential measurement which is one-fourth the circumferential of the press cylinder.

6. The liquid coating apparatus according to claim 1, wherein the endless coating plate belt has a length equivalent to the circumferential measurement of the press cylinder.

7. The liquid coating apparatus according to claim 1, wherein the endless coating plate belt has a length which is an inverse multiple of the circumferential measurement of the press cylinder.

8. The liquid coating apparatus according to claim 7, wherein the endless coating plate belt has a length which is one-half the circumferential measurement of the press cylinder.

9. An assembly including a printing press, a coating apparatus capable of operating in conjunction with the printing press and means for moving the coating apparatus into an adjoining relationship with the press so as to form a nip site through which workpieces can travel, the printing press having at least one press cylinder rotatably mounted within the press, the coating apparatus being capable of applying a liquid coating fluid to a workpiece traveling over the press cylinder, the coating apparatus comprising:

a driveable support means suitable for supporting a belt, the support means including a first and a second roller both rotatably mounted within the apparatus, at least one of the rollers being drivingly coupled to a drive means;

an endless coating plate belt for transferring the liquid coating fluid from the coating apparatus to the workpiece at the nip site, the endless coating plate belt being trained about the first and second rollers and driveable by the rollers and supported thereon, the belt including at least one opening formed therein, the opening configured and dimensioned to accommodate passage of the gripper mechanism therethrough;

drive means for driving the support means, thereby causing the endless coating plate belt to be driven about the first and second rollers;

supply means for supplying the liquid coating fluid to the endless coating plate belt; and

metering means for metering the supply of liquid coating fluid supplied to the endless coating plate belt.

10. The assembly according to claim 9, wherein the first roller includes at least one recessed area present on the surface of the first roller and wherein the at least one opening is a gripper slot formed through the thickness of the endless coating plate belt, the gripper slot being positionally aligned over the recessed area on the surface of the first roller at a selected angular rotational position of the roller.

11. The assembly according to claim 10, wherein the endless coating plate belt of the coating apparatus includes a filler piece having dimensions approximating the dimensions of the recessed area on the surface of the first roller, the filler piece being oriented on the endless coating plate belt so as to afford a cooperative communication of the filler piece with the recessed area on the surface of the first roller upon contact of the filler piece with the first roller and wherein the second roller includes a recessed area on its surface having suitable dimensions for accommodation of the filler piece in a cooperative relationship upon contact of the filler piece with the second roller.

12. The assembly according to claim 10, wherein the first roller has a circumferentially measurement which

is an inverse multiple of the circumferential measurement of the press cylinder.

13. The assembly according to claim 12, wherein the first roller has a circumferential measurement which is one fourth the circumferential measurement of the press cylinder.

14. The assembly according to claim 9, wherein the endless coating plate belt of the coating apparatus has a length equivalent to the circumferential measurement of the press cylinder.

15. The assembly according to claim 9, wherein the endless coating plate belt of the coating apparatus has a length which is an inverse multiple of the circumferential measurement of the press cylinder.

16. The assembly according to claim 15, wherein the endless coating plate belt of the coating apparatus has a length which is one half the circumferential measurement of the press cylinder.

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(54) High velocity, hot air dryer and extractor.

(57) A hot air dryer (10) utilizes high velocity air jets which scrub and break up the moist air layer which clings to the surface of a freshly printed sheet (S). High velocity air is heated to a high temperature as it flows along a resistance heating element (38) within an air delivery baffle tube (64). The heated, high velocity air pressurizes a plenum chamber (46) within an air distribution manifold (36W). High velocity jets of hot air are discharged through multiple airflow apertures (54) onto the wet ink side of a printed sheet as it moves through a dryer exposure zone (Z). An extractor (40) removes the moist air layer, high velocity hot air and volatiles from the printed sheet (S) and from the press (12).

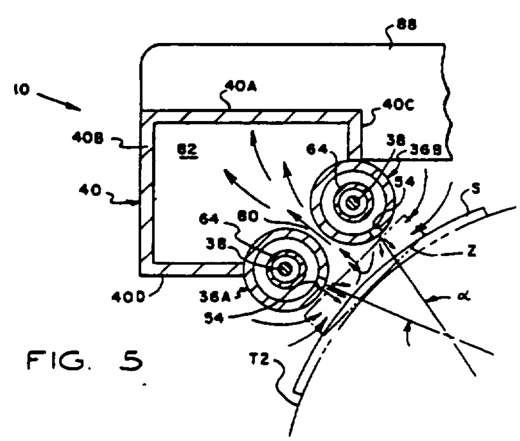

FIG. 5

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This invention relates generally to accessories for sheet-fed, rotary offset and flexographic printing presses, and in particular to a dryer for printed materials which utilizes high velocity, hot air flow and extraction.

In the operation of a rotary offset press, an image is reproduced on a web or sheet of paper or some other printable substrate by a plate cylinder which carries the image, a blanket cylinder which has an ink transfer surface for receiving the inked image, and an impression cylinder which presses the paper against the blanket cylinder so that the inked image is transferred to the paper. In some applications, a protective and/or decorative coating is applied to the surface of the freshly printed sheets. The freshly printed sheets are then transported to a sheet delivery stacker in which the printed sheets are collected and stacked.

The relatively wet condition of the printing ink composition and its solvent and/or diluent components and a layer of moisture laden air which clings to the surface of the freshly printed web or sheet may interfere with the quality of the images as they are printed at each succeeding printing unit. For example, the quality of colored images, half-tone illustrations and the like undergo degradation in the uniformity of their appearance and color because of the presence of the wet ink, volatiles, and moisture within the printed substrate. Moreover, protective coatings will undergo dilution and surface degradation causing a dull finish if the underlying substrate is not dried sufficiently before the coating is applied.

Such defects, including uneven surface appearance of protective/decorative coatings, detract from the appearance of the underlying images or photographs, particularly in the case of multi-colored images or photographs. The defects are caused by residual volatile solvents, diluents, water and the like within the oleoresinous inks of the images, and the presence of moisture in the printed material, at the time that the next successive image is printed or the protective/decorative coating is applied. Because the defects are compounded as the printed material moves through successive printing units, it is desirable that curing and drying be initiated and volatiles and moisture laden air be extracted at each interstation position, as well as at the delivery position.

Hot air dryers and radiant heaters have been used as delivery dryers and as interstation dryers. Interstation dryers employing radiant heat lamps are best suited for slow to moderate press speeds in which the exposure time of each printed sheet to the radiant heat is long enough to initiate ink setting. For high speed press operation, for example, at 5,000 sheets or more per hour, there is not enough available space at the interstation position to install a radiant heater having sufficient number of heat lamps for adequate drying purposes.

As press speed is increased, the exposure time (the length of time that a printed sheet is exposed to the radiant heat) is reduced. Since the number of lamps is limited by the available interstation space, the output power of the radiant lamps has been increased to deliver more radiant energy at higher temperatures to the printed sheets in an effort to compensate for the reduction in exposure time. The increased operating temperatures of the high-powered radiant heat lamps cause significant heat transfer to the associated printing unit and other equipment mounted on the press frame, accelerated wear of bearings and alterations in the viscosities of the ink and coating, as well as upsetting the balance between dampening solution and ink. The heat build-up may also cause operator discomfort and injury.

To handle high speed press operations, an off-press heater has been utilized from which high velocity, heated air is conveyed through a thermally insulated supply duct to a discharge plenum which directs high velocity, heated air onto the printed stock as it moves across the interstation dryer position. Such off-press heaters have proven to be relatively inefficient because of excessive heat loss and pressure drop along the supply duct. Attempts to overcome the heat loss and pressure drop have resulted in substantially increased physical size of the heater equipment (blower fan and supply duct) along with a substantial increase in the electrical power dissipated by the off-press heater.

According to the present invention, a high efficiency hot air dryer utilizes an on-press heater for producing high velocity hot air flow for accelerating the setting of inks on a freshly printed substrate. The on-press heater includes a housing member having a sidewall defining a manifold air distribution or plenum chamber, with the sidewall being intersected by an airflow discharge port. An air delivery tube has an inlet port for receiving high velocity airflow and has a tubular sidewall disposed in the plenum chamber. An elongated heating element is disposed within the inner airflow passage of the air delivery tube. High velocity air is discharged into the air delivery tube in heat transfer contact along the length of the heating element.

Heated, high velocity air is discharged out of the air delivery tube into the plenum chamber of the housing member. Preferably, the high velocity air is supplied to the manifold plenum chamber through an inlet port having an inlet flow area which is greater than the outlet flow area of the hot air discharge port. By this arrangement, heated air will be supplied to the plenum chamber faster than it can be discharged, so that the heated air will be

compressed within the manifold plenum chamber. This assures that jets of hot air which are discharged through multiple outlet apertures are uniform in pressure and velocity along the length of the dryer head, so that the printed sheet is dried uniformly as it is transferred through the exposure zone of the dryer.

According to another aspect of the present invention, the moist air layer is displaced from the surface of the printed sheet by high-velocity hot air jets which scrub and break-up the moisture-laden air layer that adheres to the printed surface of the sheet. The high-velocity hot air jets create turbulence which overcomes the surface tension of the moisture and separates the moisture laden air from the surface of the printed material. The moisture vapor and volatiles become entrained in the forced air flow and are removed from the printing unit by a high volume extractor.

The scrubbing action of the high velocity hot air jets is improved by adjacent rows of multiple discharge apertures which are oriented to deliver a converging pattern of high velocity hot air jets into an exposure zone across the sheet travel path. The high velocity hot air jets are produced by a pair of elongated dryer heads in which high velocity air is heated by heat transfer contact with a resistance heating element within an air delivery baffle tube. Since the release of moisture and other volatiles from the ink and printed material occurs continuously in response to the absorption of thermal energy, the moisture laden air layer is displaced continuously from the printed sheet as the printed sheet travels through the dryer exposure zone in contact with the converging hot air jets.

According to another aspect of the invention, the moisture-laden air, volatiles and hot air completely exhausted from the printing unit by a high volume extractor. An extractor manifold is coupled to a pair of elongated dryer heads and draws the moisture-laden air, volatiles and high velocity hot air from the exposure zone through a longitudinal air gap between the dryer heads. According to this arrangement, the setting of ink on each printed sheet is initiated and accelerated before the sheet is run through the next printing unit.

Operational features and advantages of the present invention will be understood by those skilled in the art upon reading the detailed description which follows with reference to the attached drawings, wherein:

FIGURE 1 is a schematic side elevational view in which multiple dryers of the present invention are installed at interstation positions in a four color offset rotary printing press;

FIGURE 2 is a simplified side elevational view showing the dryer of the present invention installed in an interstation position between two printing units of FIGURE 1;

FIGURE 3 is a bottom plan view showing installation of the dryer assembly of FIGURE 2 in the interstation position;

FIGURE 4 is a perspective view of the interstation dryer shown in FIGURE 2;

FIGURE 5 is a sectional view of the improved dryer of the present invention taken along the line 5-5 of FIGURE 4;

FIGURE 6 is a longitudinal sectional view of the dryer assembly shown in FIGURE 2;

FIGURE 7 is a sectional view of the dryer assembly shown in FIGURE 2, taken along the line 7-7 of FIGURE 6;

FIGURE 8 is a perspective view of a resistance heating element used in the dryer of FIGURE 2;

FIGURE 9 is a perspective view similar to FIGURE 8, with the resistance heating element enclosed in a support sheath;

FIGURE 10 is a view similar to FIGURE 4 which illustrates an alternative embodiment of the dryer head in which the discharge port is formed by an elongated slot; and,

FIGURE 11 is a perspective view, partially broken away, of the dryer head shown in FIGURE 10.

As used herein, the term "processed" refers to various printing processes which may be applied to either side of a sheet, including the application of inks and/or coatings. The term "substrate" refers to sheet material or web material.

Referring now to FIGURE 1, the high velocity hot air dryer 10 of the present invention will be described as used for drying freshly printed substrates, which are successively printed at multiple printing units in a sheet-fed, rotary offset printing press. In the exemplary embodiment, the dryer 10 of the present invention is installed at an interstation position between two printing units of a four color printing press 12 which is capable of handling individual printed sheets having a width of the approximately 40" (102 millimeters) and capable of printing 10,000 sheets per hour or more, such as that manufactured by Heidelberg Druckmaschinen AG of Germany under its designation Heidelberg Speedmaster 102V.

The press 12 includes a press frame 14 coupled on the right end to a sheet feeder 16 from which sheets, herein designated S, are individually and sequentially fed into the press, and at the opposite end, with a sheet stacker 18 in which the printed sheets are collected and stacked. Interposed between the sheet feeder 16 and the sheet stacker 18 are four substantially identical sheet printing units 20A, 20B, 20C and 20D which can print different color inks onto the sheets as they are moved through the press.

As illustrated in FIGURE 1, each sheet fed printing unit is of conventional design, each unit including a plate cylinder 22, a blanket cylinder 24 and an impression cylinder 26. Freshly printed sheets S from the impression cylinder 26 are transferred to the next printing unit by transfer cylinders T1, T2, T3. A protective coating may be applied to the printed sheets by a coating unit 28 which is positioned adjacent to the last printing unit 20D.

The freshly printed and coated sheets S are transported to the sheet stacker 18 by a delivery conveyor system, generally designated 30. The delivery conveyor 30 is of conventional design and includes a pair of endless delivery gripper chains 32 carrying laterally disposed gripper bars having a gripper element for gripping the leading edge of a freshly printed sheet S as it leaves the impression cylinder 26. As the leading edge of the printed sheet S is gripped by the grippers, the delivery chains 32 pull the gripper bar and sheet S away from the impression cylinder 26 and transports the freshly printed and/or coated sheet to the sheet stacker 18.

Prior to delivery, the freshly printed sheets S pass through a delivery dryer 34 which includes a combination of infra-red thermal radiation, forced air flow and extraction.

Referring now to FIGURE 2, FIGURE 5 and FIGURE 6, the interstation dryer 10 includes as its principal components a dryer head 36, a resistance heating element 38, and an extractor head 40. As shown in FIGURE 3, the dryer head 36 is mounted on the press side frame members 14A, 14B by side frame flanges 42, 44. In this interstation position, the dryer head 36 is extended laterally across and radially spaced from the interstation transfer cylinder T2, thereby defining an exposure zone Z.

The dryer head 36 includes a tubular sidewall 36W which encloses an air distribution manifold chamber 46. The air distribution manifold housing is sealed on opposite ends by end plates 48, 50, respectively, and is sealed against the extractor head 40. The manifold housing has an inlet port 52 for admitting high velocity, pressurized air through a supply duct 52 from an off-press compressor 53, and has a discharge port for delivering pressurized hot air into the exposure zone Z.

As shown in FIGURE 6, the air distribution manifold sidewall 36W is intersected by multiple discharge apertures 54 which collectively define the discharge port. The apertures 54 are oriented for discharging pressurized jets of high velocity, hot air toward the interstation transfer cylinder T2, and are longitudinally spaced along the dryer head 36. According to this arrangement, pressurized air jets are directed along a straight line across the printed side of a sheet S as it moves through the dryer exposure zone Z. In an alternative embodiment, as shown in FIGURE 10 and FIGURE 11, the discharge port is formed by an elongated slot 55 which intersects the dryer head sidewall 36W and extends longitudinally along the dryer head.

Referring now to FIGURE 6 and FIGURE 7, the resistance heating element 38 is coupled to the dryer head 36 by and end block 56. The end block 56 has a body portion which is intersected by an axial bore 58, a counterbore 60 and a radial inlet bore 62 which communicates with the counterbore. The heating element 38 has an end portion 38A which projects through the axial bore 58 and counterbore 60, with the elongated body portion of the heating element 38 extending into the plenum chamber 46.

According to an important feature of the present invention, the plenum chamber 46 is partitioned by an elongated air delivery baffle tube 64 which extends substantially the entire length of the dryer head 36. The air delivery baffle tube 64 has an inlet port 66 for receiving high velocity airflow from a remote supply and has a tubular sidewall 64A extending through the plenum chamber. The tubular sidewall 64A has an inner airflow passage 68 which connects the inlet port 66 in airflow communication with the plenum chamber 46 through its open end 64E. The air delivery baffle tube 64 has an end portion 64B projecting through the axial bore 60 of the end block 56, with its inner airflow passage 66 in airflow registration with the radial bore 62.

A pneumatic connector 70 is coupled to the radial inlet bore 62 of the end block 56 for connecting the inner airflow passage 68 to an off-press source of high velocity air. The end block 56 is sealed against the end plate 50, the tubular sheath 78 and against the pneumatic connector 70. High velocity, pressurized air is constrained to flow from the air duct 52 into the airflow passage 68 where it is discharged into the air distribution plenum chamber 46 after absorbing heat from the heating element 38.

As shown in FIGURE 6, the high velocity air flows longitudinally through the annular flow passage 68 in heat transfer contact with the heating element 38. The high velocity air is heated to a high temperature, for example 350 °F (176 °C), before it is discharged through the airflow apertures 54.

To provide uniform air jet discharge through the apertures 54, the inlet area of the inlet port 66 should be greater than the combined outlet area provided by the multiple airflow discharge apertures 54. In the preferred embodiment, the discharge apertures 54 have a diameter of 1/16 inch (0.158 cm), and for a 40" (102 mm) press there are 88 apertures spaced apart along the dryer head 36 on 0.446 inch (1.13 cm) centers. This yields a total

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airflow outlet area of 0.269 square inch (1.735 square cm). Preferably, the effective inlet area of the inlet port 66 is at least about 0.54 square inch (3.484 square cm).

In the alternative dryer head embodiment shown in FIGURE 10, the air discharge slot 55 has a length of 40 inches (102 mm) along its longitudinal dimension L, and has an arc length C of 6.725 mils (17×10^{-3} cm).

With the preferred inlet/outlet ratio of about 2:1 or more, the high velocity, heated air will be supplied to the plenum chamber 46 faster than it can be discharged, so that the heated air will be compressed within the manifold plenum chamber. This assures that the jets of hot air which are discharged through the outlet apertures 54 are uniform in pressure and velocity along the length of the dryer head, so that the printed sheet is dried uniformly as it is transferred through the exposure zone Z.

The air distribution baffle tube 64 is supported on the inlet end by the end plate 50, and on its discharge end by flange segments 64F which engage the internal bore of the dryer head 36 and positions the baffle tube in the center of the plenum chamber 46.

Referring now to FIGURE 6, FIGURE 7, FIGURE 8 and FIGURE 9, the heating element 38 is preferably an electrical resistance heater having elongated resistance heater sections 38C, 38D which are integrally formed and folded together about at a common end 38E. The resistance sections 38C, 38D are substantially co-extensive in length with the air delivery baffle tube 64. Each section 38C, 38D is electrically connected to a power conductor 72, 74, respectively, for connecting the resistance heating element 38 to an off-press source of electrical power.

The resistance heater sections 38C, 38D are mechanically stabilized by an end connector 76, and are enclosed within a tubular, thermally conductive sheath 78. Radial expansion of the half sections 38C, 38D is limited by the sidewall of the sheath 78, thus assuring efficient heat transfer, while the sheath provides longitudinal support for the elongated resistance heater sections within the inner airflow passage 68. The heating element half-sections 38C, 38D thus form a continuous loop resistance heating circuit which is energized through the power conductors 72, 74.

The tubular sheath 78 is received within the bore 58 and is welded to the end block 56. The tubular sheath 78 thus provides an opening through the end block 56 to permit insertion and withdrawal of the heating element 38 for replacement purposes. The heating element 38 is dimensioned for a sliding fit within the sheath 78 at ambient temperature. The end cap 76 is releasably secured to the end block 56 by a hold-down metal strap (not illustrated). The distal end 78B of the sheath is sealed by an end cap 78C to prevent leakage of high velocity air out of the distribution manifold chamber 46.

Referring now to FIGURE 2, FIGURE 4, and FIGURE 5, the extractor head 40 is coupled to the back side of a pair of identical dryer heads 36A, 36B. The dryer heads 36A, 36B are separated by a longitudinal air gap 80 which opens in air flow communication with an extractor manifold chamber 82, thereby defining a manifold inlet port. The extractor manifold chamber 82 is enclosed by the end plates 48, 50 and by housing panels 40A, 40B, 40C and 40D. The extractor housing panels 40C, 40D are secured and sealed by a welded union to the dryer heads 36A, 36B.

According to another aspect of the present invention, the multiple air flow apertures 54 of each dryer head 36A, 36B are arranged in linear rows R1, R2, respectively, and extend transversely with respect to the direction of sheet travel as indicate by the arrows S in FIGURE 3. The rows R1, R2 are longitudinally spaced with respect to each other along the sheet travel path. Each air jet expands in a conical pattern as it emerges from the airflow aperture 54. Expanding air jets from adjacent rows intermix within the exposure zone Z, thereby producing turbulent movement of high velocity hot air which scrubs the processed side of the sheet S as it moves through the exposure zone Z. Preferably, balanced air pressure is applied uniformly across the exposure zone Z to ensure that the moist air layer is completely separated and extracted from the freshly printed sheets.

In the exemplary embodiment, the pressure of the high velocity air as it is discharged through the inlet port 66 into the heat transfer passage 68 is about 10 psi (7031 Kgs/m^2). The inlet suction pressure in the longitudinal air gap 80 of the extractor is preferably about 5 inches of water (12.7×10^3 Kgs/cm^3).

As shown in FIGURE 3 and FIGURE 5, the extractor manifold inlet port 80 is coupled in air flow communication with the exposure zone Z for extracting heat, moisture laden air and volatiles out of the dryer. The extractor manifold chamber 82 is coupled in air flow communication with an exhaust fan 84 by an air duct 86. The air duct 86 is coupled to the extractor manifold chamber 82 by a transition duct fitting 88.

The high velocity, heated air which is discharged onto the printed sheet S is also extracted along with the moisture and volatiles through the air gap 80 into the extractor chamber 82. Ambient air, as indicated by the curved arrows, is also suctioned into the exposure zone Z and through the longitudinal air gap, thus assuring that hone of

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the hot air, moisture or volatiles will escape into the press area. Extraction from the exposure zone Z is enhanced by directing the hot air jets along converging lines whose intersection defines an acute angle alpha (α), as shown in FIGURE 5.

The air flow capacity of the exhaust fan 84 is preferably about four times the total airflow input to the dryer heads. This will ensure that the exposure zone Z is maintained at a pressure level less than atmospheric thereby preventing the escape of hot air, moisture laden air and volatiles into the press room.

Claims

1. A hot air dryer (10) for installation in a printing press (12), said dryer comprising a dryer head (36) having a housing member (36W) defining an air distribution chamber (46), the housing member having an airflow inlet port (52) for receiving high velocity air and an airflow discharge port (54, 55) for directing heated air onto a substrate (S), and including a heating element (38) disposed in the air distribution chamber, characterized in that:
   an air delivery tube (64) is disposed in the air distribution chamber, the air delivery tube having an elongated airflow passage (68) connecting the inlet port in airflow communication with the air distribution chamber; and
   the heating element (38) is disposed within the elongated airflow passage (68) of the air delivery tube (64).

2. A hot air dryer (10) as defined in claim 1, characterized in that:
   pneumatic connector means (70) are coupled to the air delivery tube (64) for connecting the elongated air flow passage (68) to a source of high velocity air.

3. A hot air dryer (10) as defined in claim 1 or claim 2, characterised in that:
   electrical conductors (72, 74) are coupled to the heating element (38) for connecting the heating element to a source of electrical power.

4. A hot air dryer (10) as defined in any one of claims 1 to 3, characterized in that:
   an end block (56) is coupled to the housing member (36) and to the air delivery tube (64) for sealing the interface between the air delivery tube and the housing member.

5. A hot air dryer (10) as defined in any one of claims 1 to, characterised in that:
   an end block (56) is coupled to the housing member (36), the end block having a body portion intersected by an axial bore (58), a counterbore (60) and a radial inlet bore (62) communicating with the counterbore;
   the heating element (38) having an end portion (38A) projecting through the axial bore and counterbore; and,
   the air delivery tube (64) having an end portion (64B) disposed in the counterbore (60) with its elongated airflow passage (68) being coupled in airflow communication with the radial inlet bore (62).

6. A hot air dryer (10) as defined in any one of the preceding claims, characterized in that:
   the elongated heating element (38) comprises an electrical resistance heater (38C, 38D).

7. A hot air dryer (10) as defined in claim 6, characterized in that:
   the heating element (38) has first and second resistance heater sections (38C,38D), the sections being joined at a common end (38E) and disposed in side-by-side relation.

8. A hot air dryer (10) as defined in any one of the preceding claims, characterized in that:
   a tubular, thermally conductive sheath (78) is disposed within the elongated airflow passage (68); and,
   the heating element (38) is disposed within the sheath.

9. A hot air dryer (10) as defined in any one of the preceding claims, characterized in that:
   an extractor head (40) is coupled to the dryer head (36), the extractor head including a housing member (40A, 40B, 40C, 40D) defining an extractor manifold chamber (82), the extractor head having an elongated inlet port (80) for extracting air from a dryer exposure zone Z into the extractor manifold chamber, and having discharge means (84, 86, 88) coupled to the extractor head for exhausting air from the extractor manifold chamber.

10. A hot air dryer (10) as defined in any one of the preceding claims, characterized in that:
    the airflow discharge port (54) comprises multiple airflow apertures.

11. A hot air dryer (10) as defined in any one of the preceding claims, characterized in that:
    the air discharge port (54) comprises an elongated slot (55).

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12. A hot air dryer (10) as defined in any one of the preceding claims, characterized in that:

the dryer head (36) is adapted for installation in an interstation position between adjacent printing press units (20A, 20B, 20C, 20D, 18) of a printing press (12), with the airflow discharge port (54, 55) facing the processed side of a substrate (S) as it is transported along a substrate travel path.

13. A hot air dryer (10) as defined in any one of the preceding claims, characterized in that:

the dryer (10) includes a second dryer head (36B) disposed in side-by-side relation with the first dryer head (36A) in a position facing the freshly processed side of a substrate (S) as it moves through a dryer exposure zone (Z) along a substrate travel path, the second dryer head (36B) having a housing member (36W) defining a second air distribution chamber (46), the housing member of the second dryer head including an inlet port (52) for receiving high velocity air and a discharge port (54, 55) oriented for directing heated air toward the sheet travel path, with the dryer heads being separated from each other by a longitudinal air gap (80); and,

an extractor head (40) is coupled to the dryer heads (36A, 36B), the extractor head including a housing member (40A, 40B, 40C, 40D) defining an extractor manifold chamber (82) and coupled in air flow communication with the longitudinal air gap (80), and having discharge means (84, 86, 88) coupled in air flow communication with the housing member for exhausting air from the extractor manifold chamber (82).

14. A hot air dryer (10) as defined in claim 13, characterized in that:

the discharge ports (54, 55) of the dryer heads are arranged in first and second rows (R1, R2), respectively, the rows being separated from each other along the substrate travel path, wherein heated air discharged from the discharge ports intermix with each other in the dryer exposure zone (Z).

15. A hot air dryer (10) as defined in claim 13 or claim 14, characterised in that:

the discharge ports (54, 55) of the first and second dryer heads are oriented for directing heated air along first and second converging lines (FIGURE 5), respectively.

16. A method for drying a freshly processed substrate (S) in a printing press (12) characterized by the steps:

directing high velocity air through an air delivery tube (64) which is disposed within an air distribution chamber (46);

heating high velocity air flowing through the air delivery tube by heat transfer contact with an elongated heating element (38) disposed within the air delivery tube; and,

discharging heated air from the air distribution chamber onto the freshly processed substrate (S).

17. A method for drying a freshly processed substrate (S) as defined in claim 16, characterized by the step:

compressing the heated air in the air distribution chamber (46) before the heated air is discharged.

18. A method for drying a freshly processed substrate (S) as defined in claim 16 or claim 17, characterised by the steps:

discharging heated air from the air distribution chamber (46) through an outlet port (54, 55); and

supplying the high velocity air to the air distribution chamber (46) through an inlet port (52) having an inlet flow area which is greater than the outlet flow area of the outlet port.

19. A method for drying a freshly processed substrate (S) as defined in any one of claims 16 to 18, characterised by the steps:

discharging jets of heated air from the air distribution chamber (46) through first and second rows (R1, R2) of outlet apertures (54, 55); and

intermixing air jets from the first and second rows in an exposure zone (Z).

20. A method for drying a freshly processed substrate (S) as defined in any one of claims 16 to 18, characterized by the steps:

discharging jets of heated, pressurized air from the air distribution chamber (46) through first and second rows (R1, R2) of outlet apertures; and

directing air jets discharged from air flow apertures of the first and second rows (R1, R2) along first and second converging lines (FIGURE 5), respectively.

21. A method for drying a freshly processed substrate (S) as defined in any one of claims 16 to 20, characterised by the steps:

installing first and second dryer heads (36A, 36B) in side-by-side relation on a printing press (12) in a position facing the processed side of a freshly processed substrate as it

travels through a dryer exposure zone (Z), the dryer heads being separated from each other by a longitudinal air gap (80);

supplying high velocity air to each dryer head (36A, 36B) through first and second air delivery tubes (64) which are disposed within an air distribution chamber (46) in each dryer head, respectively;

heating high velocity air flowing through each air delivery tube (64) by heat transfer contact with an elongated heating element (38) disposed within each air delivery tube;

discharging heated air from each dryer head through the dryer exposure zone (Z) and onto the freshly processed substrate (S); and

extracting air from the exposure zone (Z) through the longitudinal air gap (80).

22. A method for drying a freshly processed substrate (S) as defined in claim 21, characterized by the steps:

discharging heated air from each dryer head (36A, 36B) through an airflow outlet aperture (54, 55); and

supplying high velocity air to each dryer head through an inlet port (52) having an effective inlet flow area which is greater than the combined outlet flow areas of the air flow outlet apertures (54, 55).

23. A method for drying a freshly processed substrate (S) as defined in claim 21, or claim 22, characterised by the steps:

discharging jets of heated air from the first and second dryer heads (36A, 36B) through first and second rows (R1, R2) of outlet apertures (54, 55), respectively; and

intermixing air jets from the first and second rows in the exposure zone (Z).

24. A method for drying a freshly printed substrate (S) as defined in any one of claims 21 to 23, characterized by the steps:

discharging jets of heated air from the first and second dryer heads (36A, 36B) through first and second rows (R1, R2) of outlet apertures (54, 55), respectively; and

directing air jets discharged from air flow apertures of the first and second rows (R1, R2) along first and second converging lines (FIGURE 5), respectively.

25. A method for drying a freshly processed substrate (S) as defined in any one of claims 21 to 24, characterised by the step:

extracting air from the exposure zone (Z) at a volume flow rate through the longitudinal air gap (80) which exceeds the total volume flow rate of air discharged from the first and second dryer heads (36A, 36B).

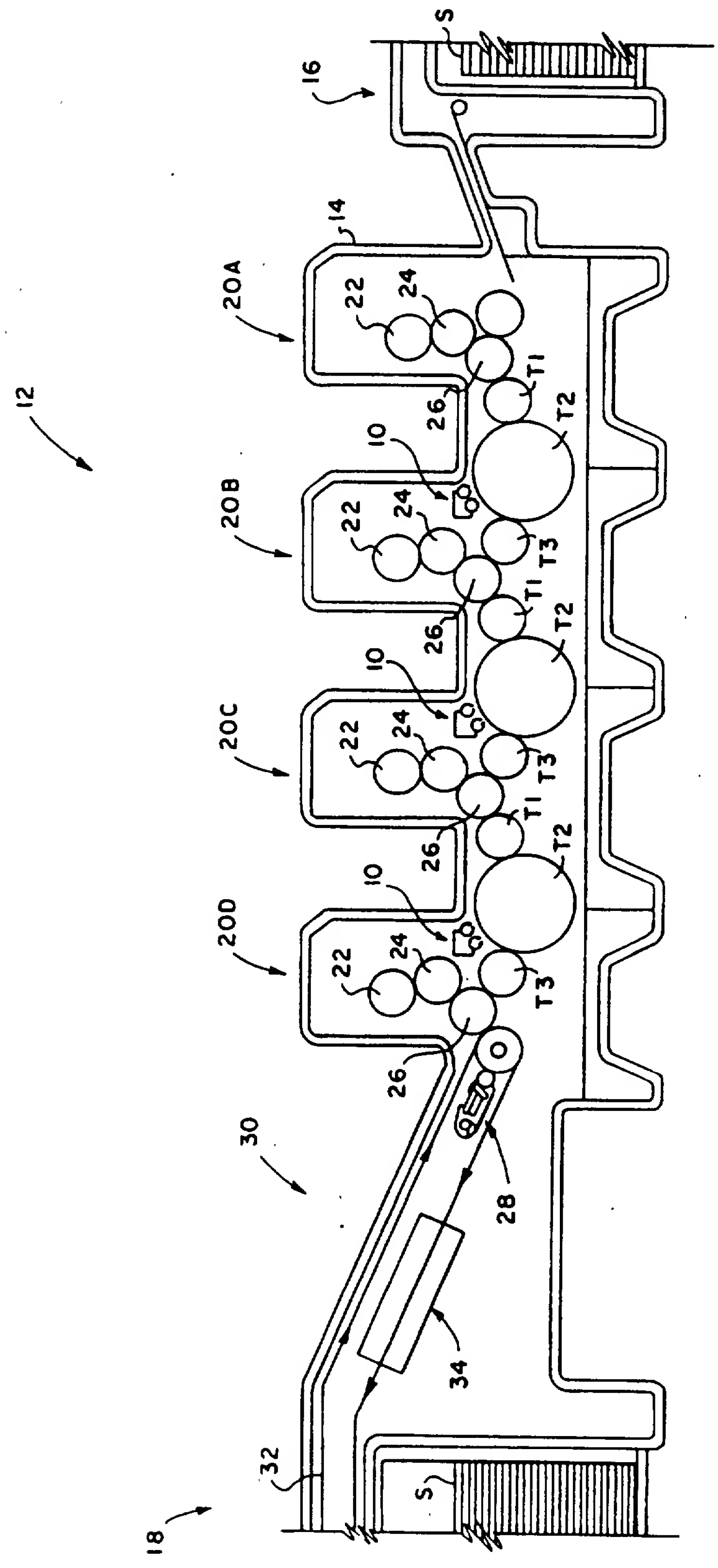


FIG. 1

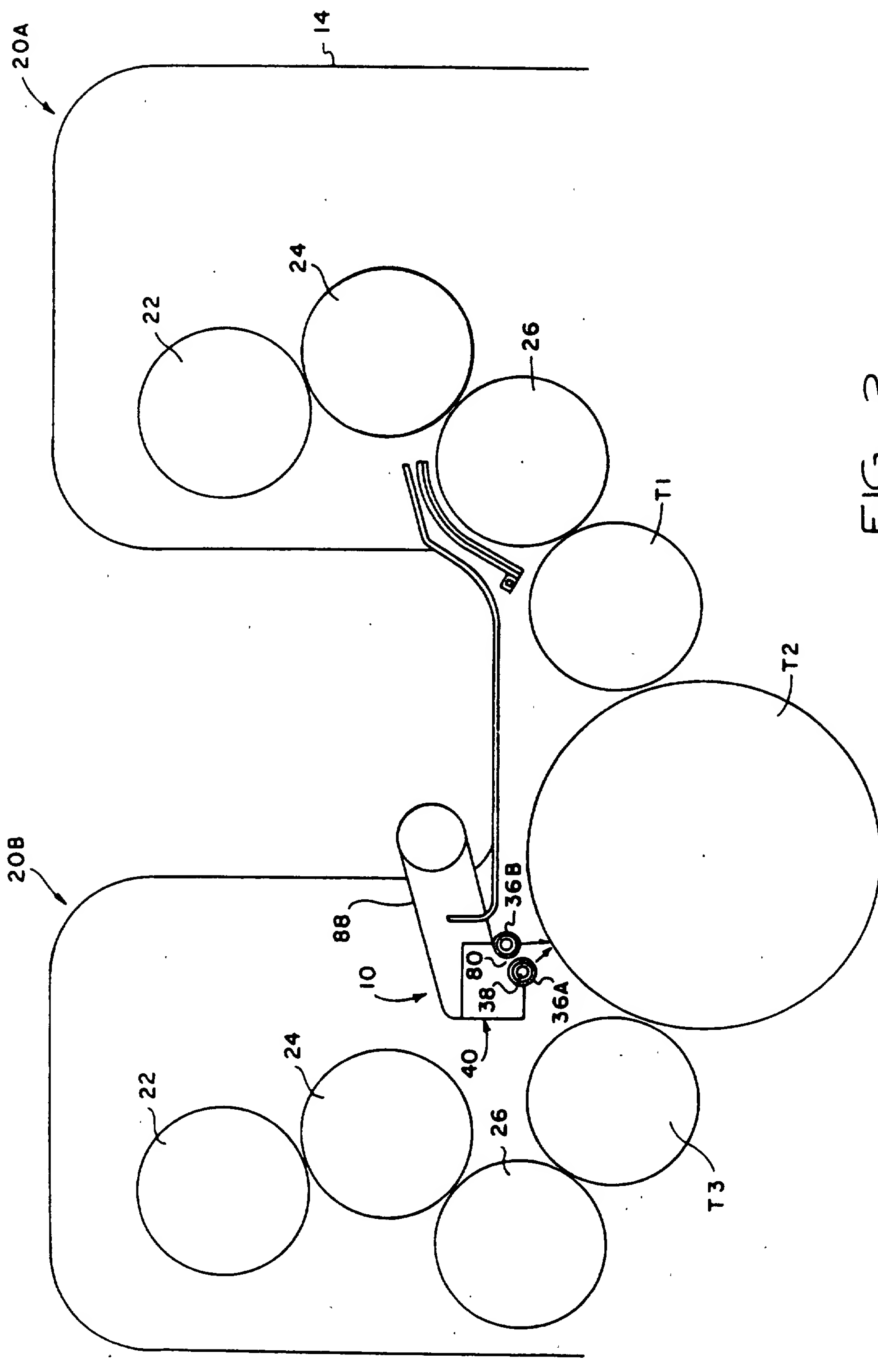


FIG. 2

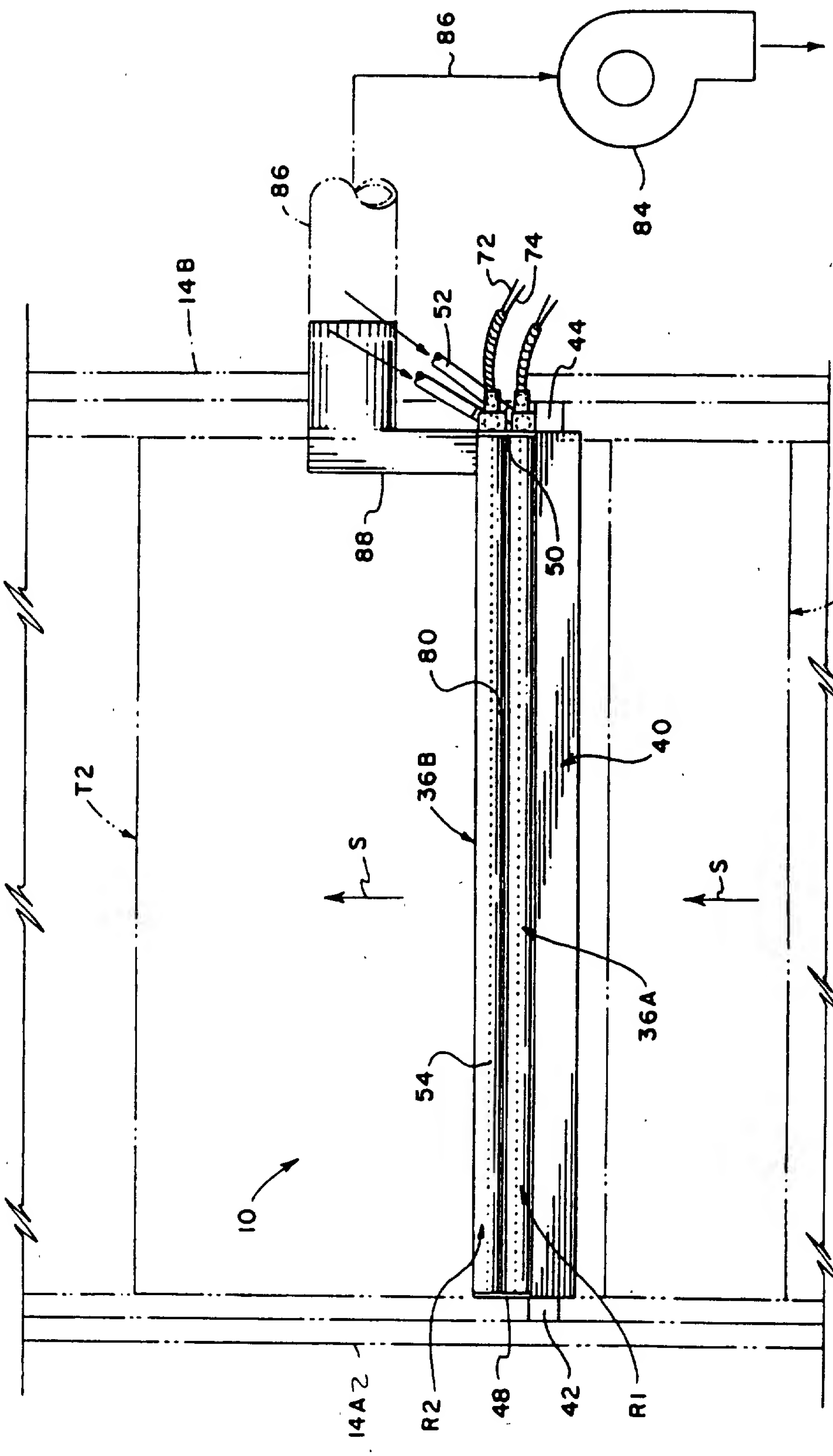
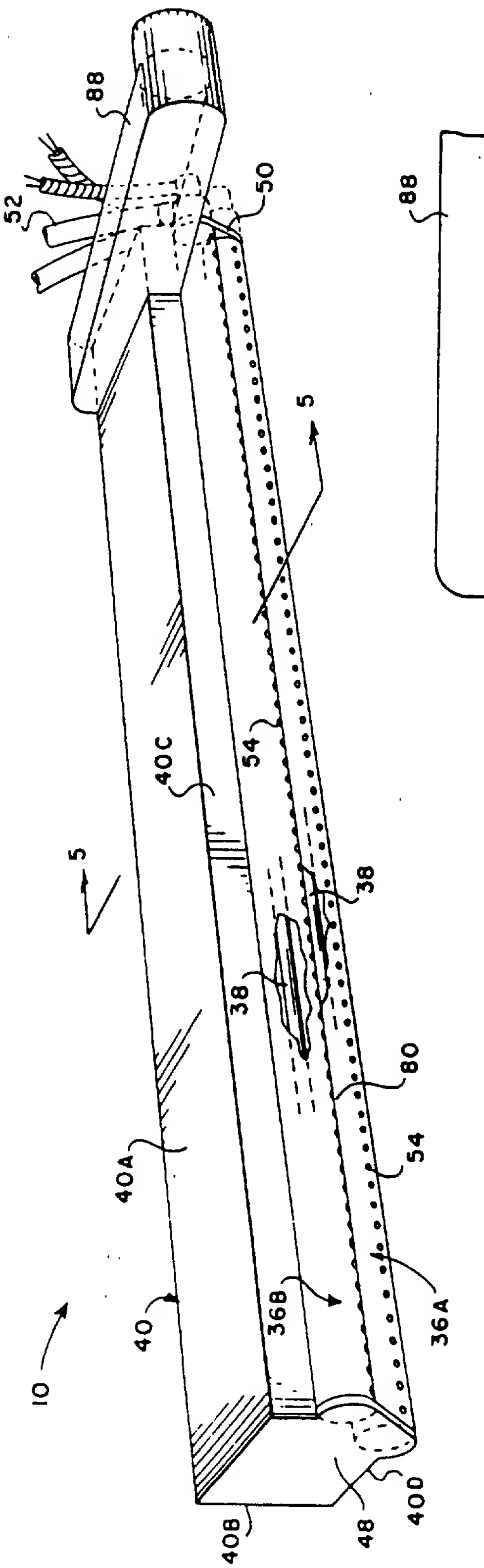

86
84
72
74
52
14B
44
88
50
T1
80
40
36B
T2
S
S
36A
54
10
R2
48
42
R1
14A

FIG. 3


10
40
40A
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40C
40D
48
36A
36B
54
80
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38
5
5
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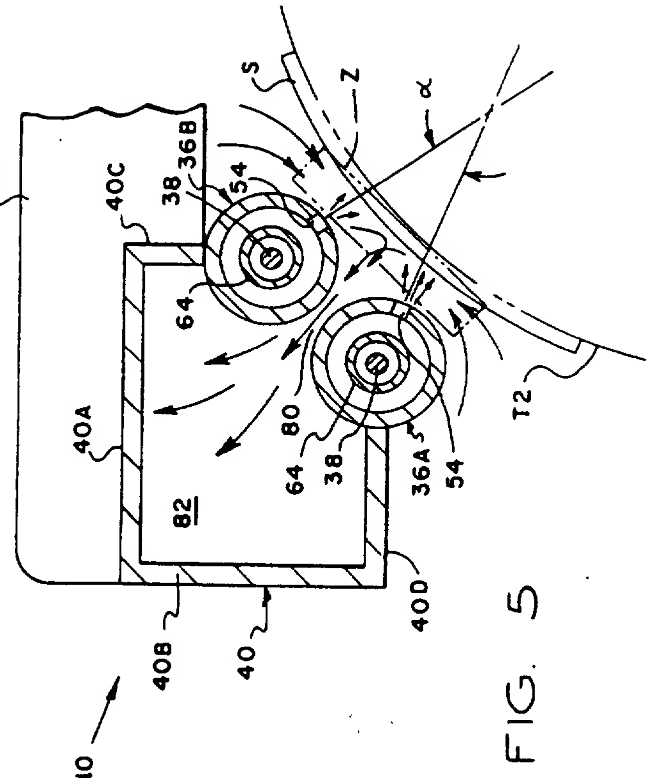
52
88

FIG. 4


10
88
40C
38
36B
54
64
40A
82
80
64
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36A
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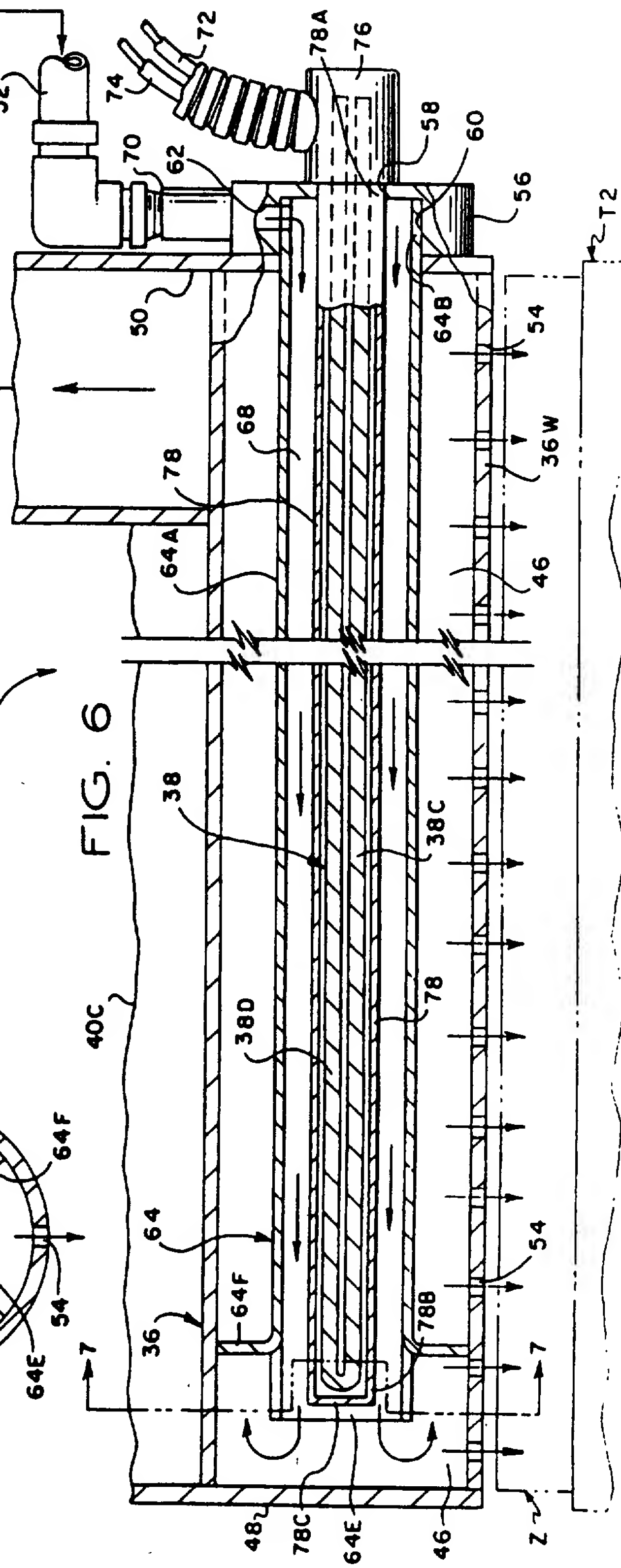
40D
40B
40
S
Z
α
T2

FIG. 5


52
53
52
70
62
74
72
78A
76
58
60
56
T2
88
50
64B
54
68
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36W
64A
46
10
38
38C
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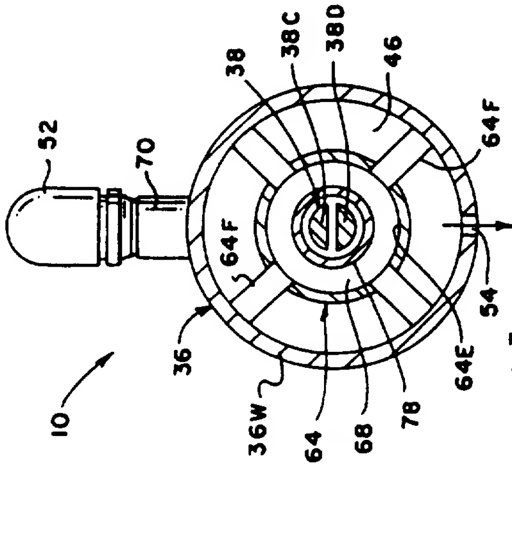
64F
36
78B
7
7
48
78C
64E
46
Z

FIG. 6


52
70
38
38C
38D
46
64F
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36
54
64E
10
36W
64
68
78

FIG. 7

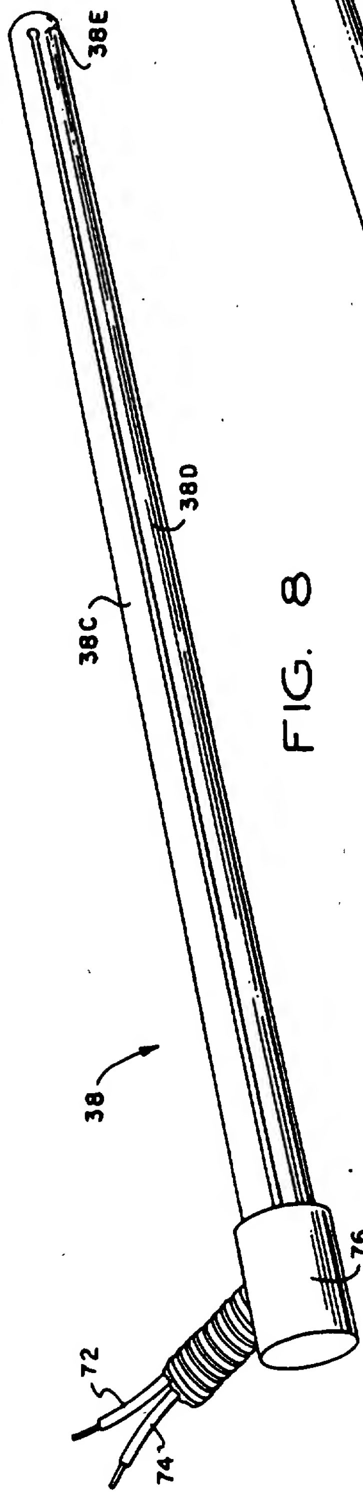

FIG. 8

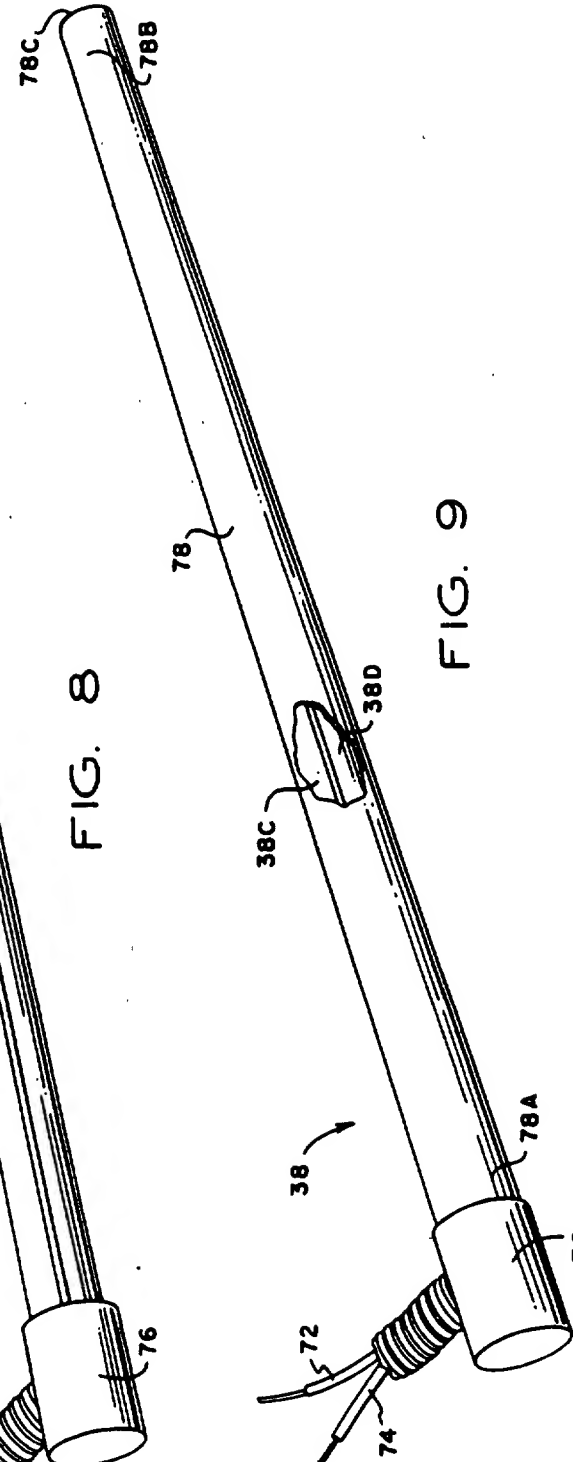

FIG. 9

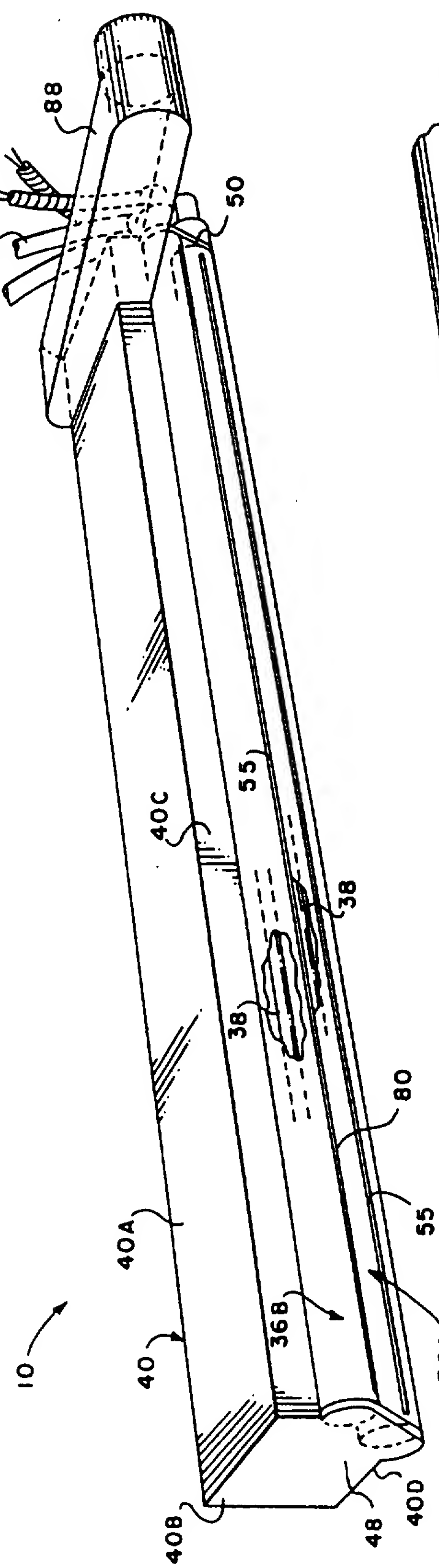

FIG. 10

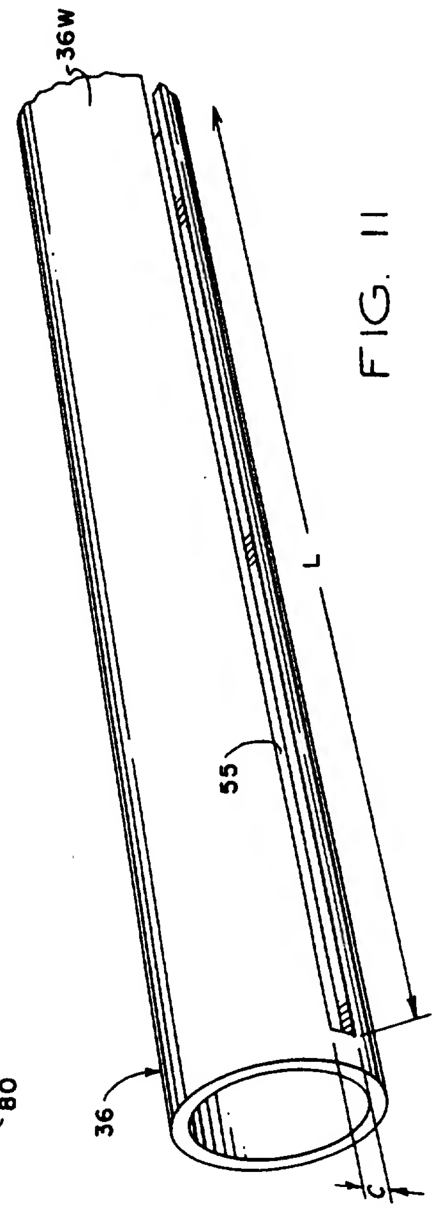

FIG. 11

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 30 5812

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION
X	US-A-2 683 939 (MASTER APPLIANCE) * the whole document *	1-4,6,7, 10,16,17	B41F23/04 F26B21/00
Y		9,12,13, 19,21,23	
Y	FR-A-1 340 311 (ATELIERS ET CHANTIERS DE NANTES) * the whole document *	9,13,19, 21,23	
Y	US-A-1 737 174 (WILLIAM J. PRICE) * the whole document *	12	
A	US-A-3 079 702 (JAMES HALLEY & SONS)		
A	WO-A-90 03888 (PLATSCH)		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B41F
F26B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16 January 1995	Loncke, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

71

US005335596A

United States Patent [19]

DeMoore et al.

[11] Patent Number: 5,335,596

[45] Date of Patent: * Aug. 9, 1994

[54] COATING APPARATUS FOR SHEET-FED, OFFSET ROTARY PRINTING PRESSES

[75] Inventors: Howard W. DeMoore, 10954 Shady Trail, Dallas, Tex. 75220; Steven M. Person, Seagoville, Tex.

[73] Assignee: Howard W. DeMoore, Dallas, Tex.

[*] Notice: The portion of the term of this patent subsequent to May 4, 2010 has been disclaimed.

[21] Appl. No.: 52,763

[22] Filed: Apr. 26, 1993

Related U.S. Application Data

[63] Continuation of Ser. No. 879,841, May 6, 1992, Pat. No. 5,207,159, which is a continuation-in-part of Ser. No. 752,778, Aug. 30, 1991, Pat. No. 5,176,077.

[51] Int. Cl.[5] B41F 31/00

[52] U.S. Cl. 101/350; 101/351; 101/367; 101/147; 118/261

[58] Field of Search 101/350, 351, 352, 137, 101/147, 148, 157, 167, 169, 207, 208, 219, 329, 330, 331, 348, 349, 364, 365, 366, 367; 118/602, 612, 236, 242, 259, 261, 262

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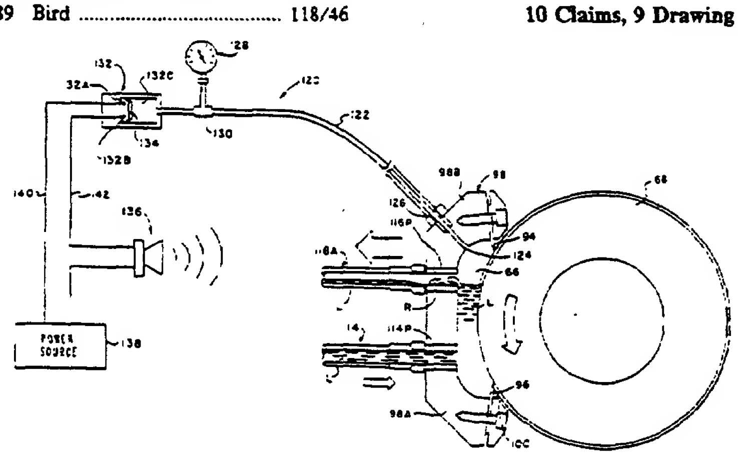
Primary Examiner—Eugene H. Eickholt

Attorney, Agent, or Firm—Dennis T. Griggs

[57] ABSTRACT

A coating apparatus for use in a sheet-fed or web-fed, offset rotary or flexographic printing press to apply a protective and/or decorative coating to the surface of freshly printed sheets includes a doctor blade coating unit coupled to a pickup roller for supplying liquid material from a reservoir to the surface of a pickup roller mounted on a press delivery drive shaft. Liquid material is circulated through the reservoir of the doctor blade unit by suction flow produced by a return pump. This prevents the buildup of a positive pressure differential within the doctor blade reservoir. The doctor blade reservoir is maintained at below ambient pressure level, thereby preventing leakage through the end seals. A vacuum sensor circuit provides a visual indication of air vacuum pressure in the doctor blade reservoir chamber, and a vacuum sensor switch applies electrical power to an audio transducer. The audio transducer produces an audible alarm in response to an increase in doctor blade chamber pressure, thereby providing advance warning of an impending end seal failure or a worn doctor blade condition.

10 Claims, 9 Drawing Sheets



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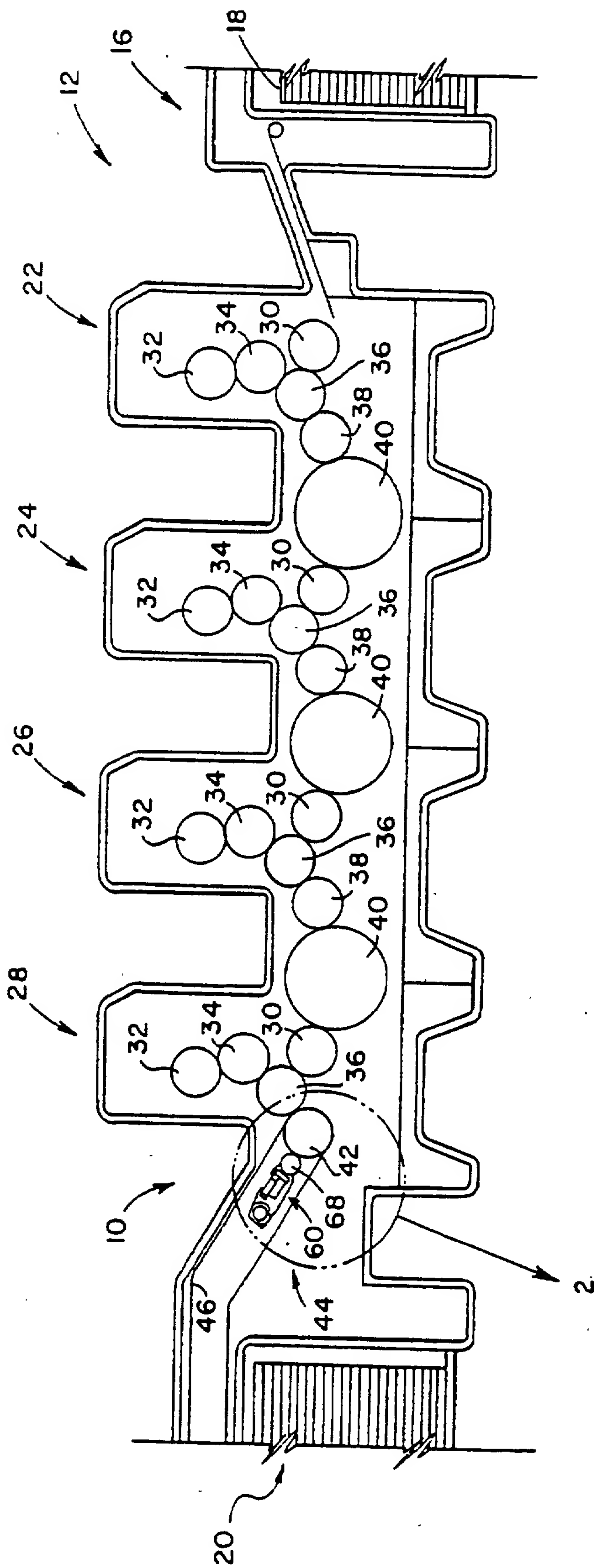
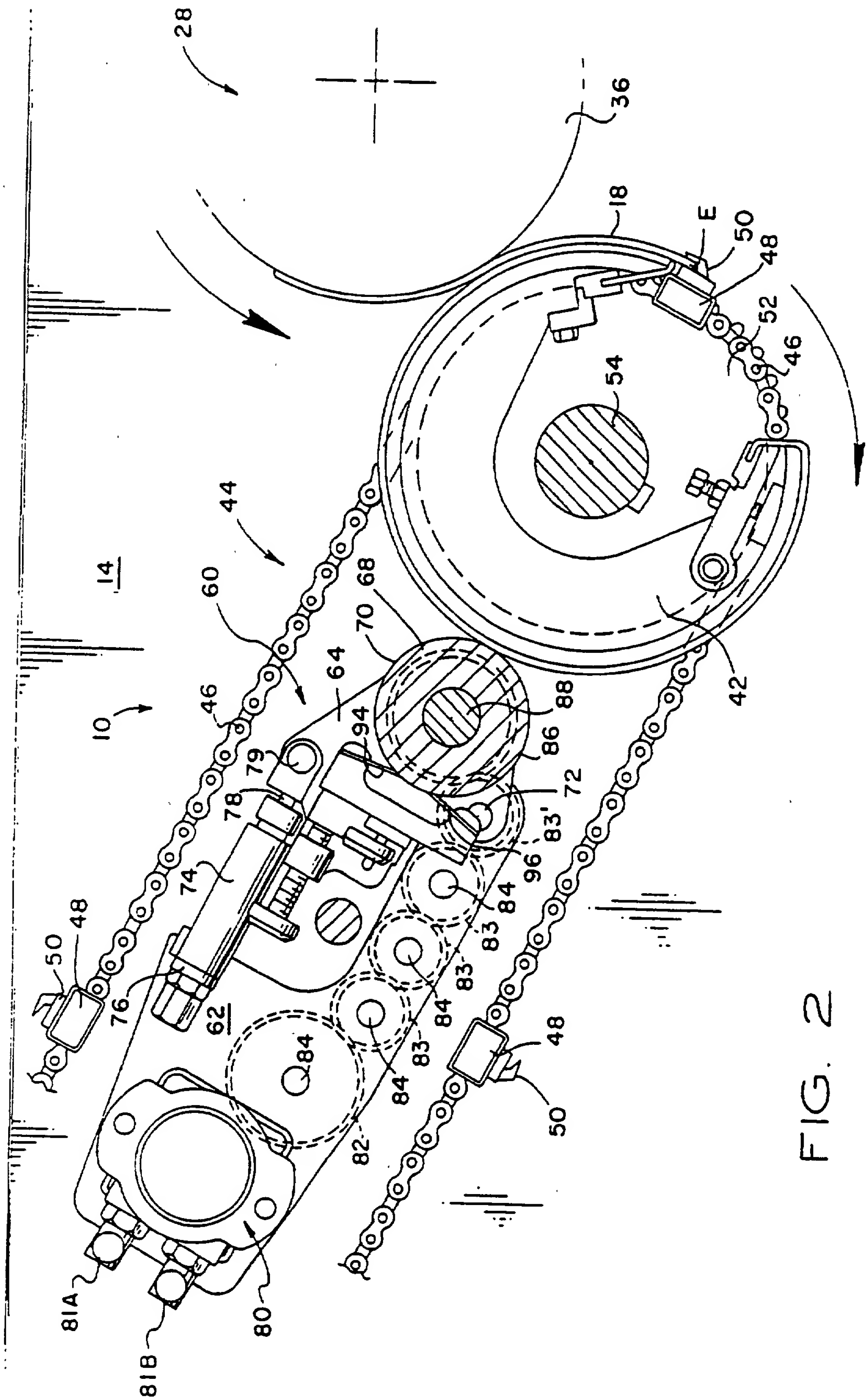


FIG. 1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81A
81B
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FIG. 2

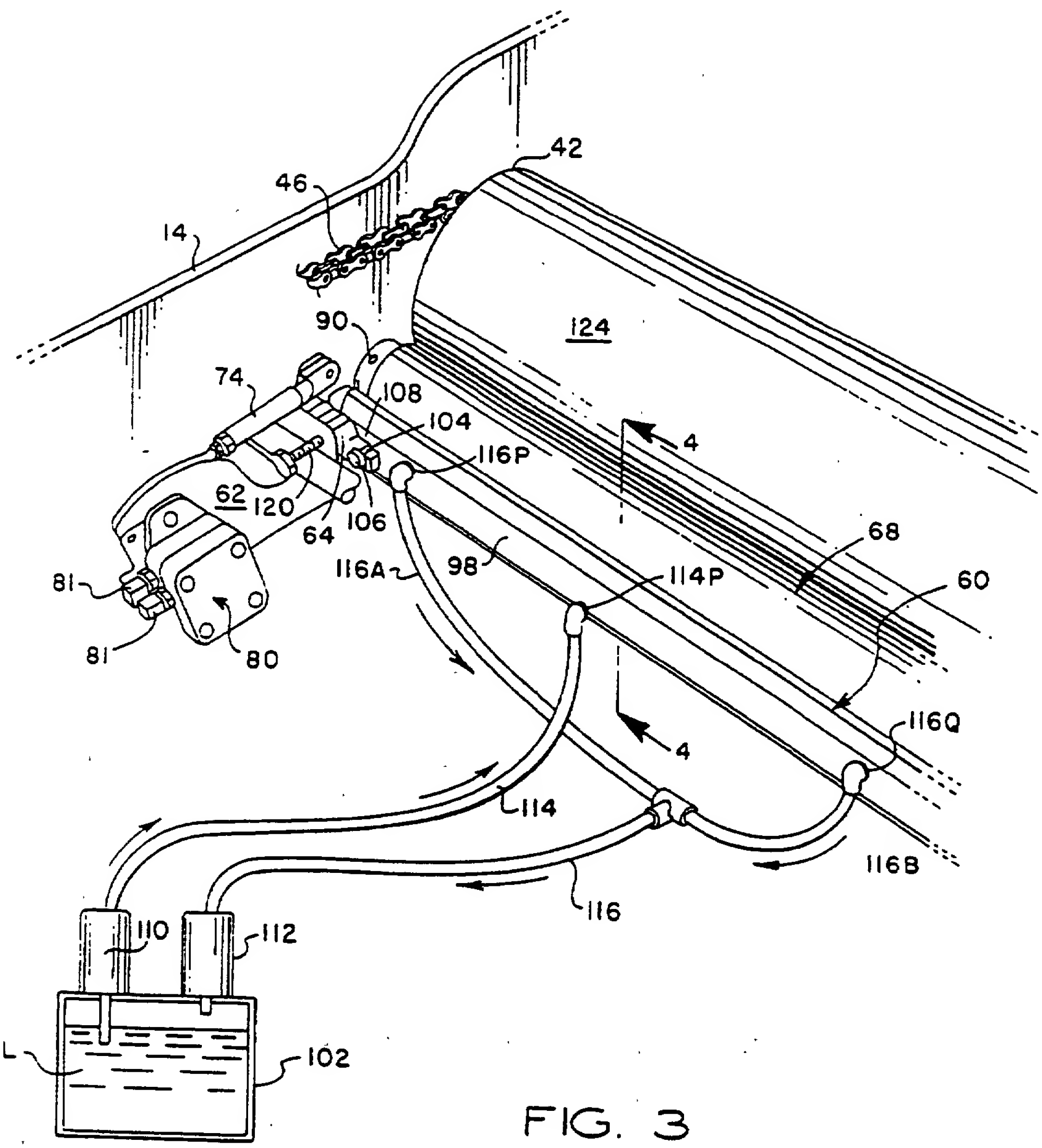
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FIG. 3

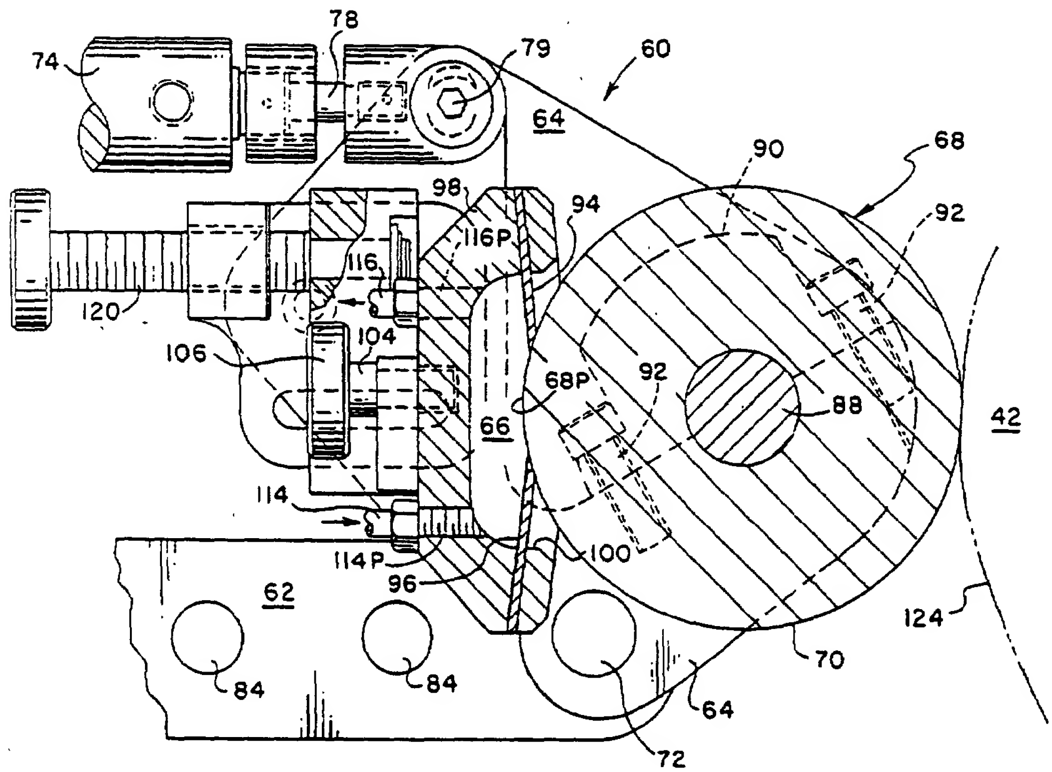
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FIG. 4

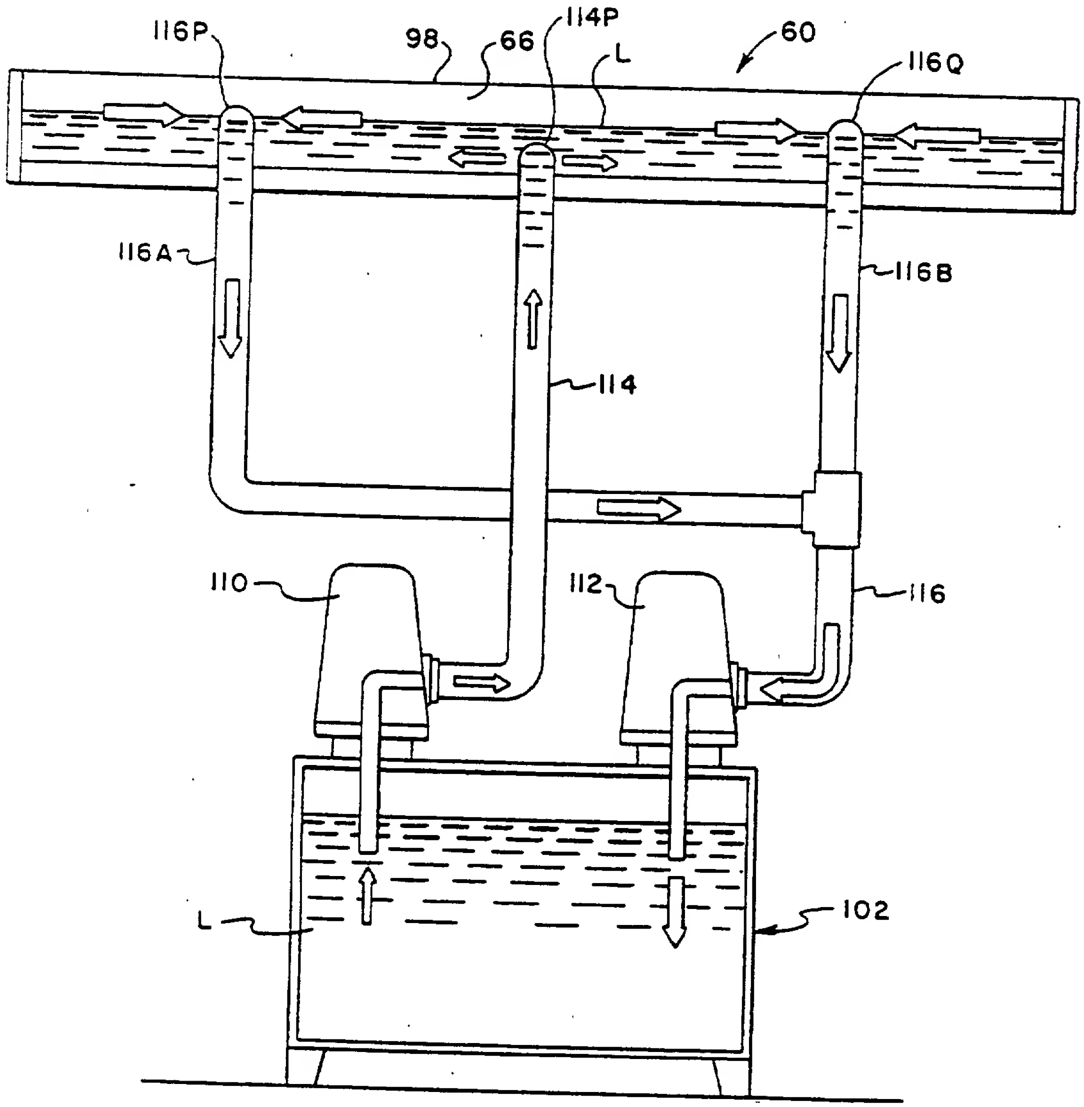


FIG. 5

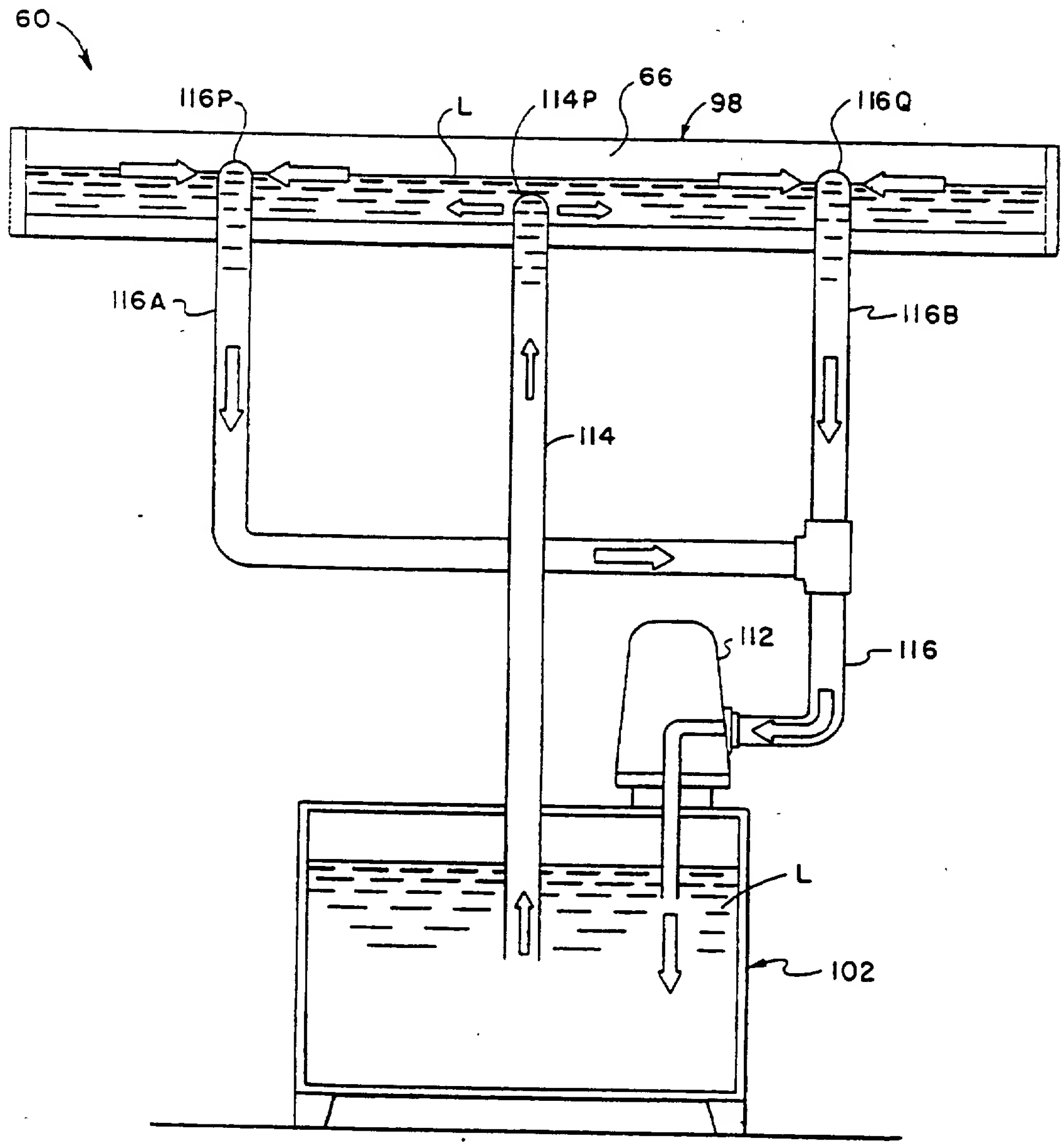


FIG. 6

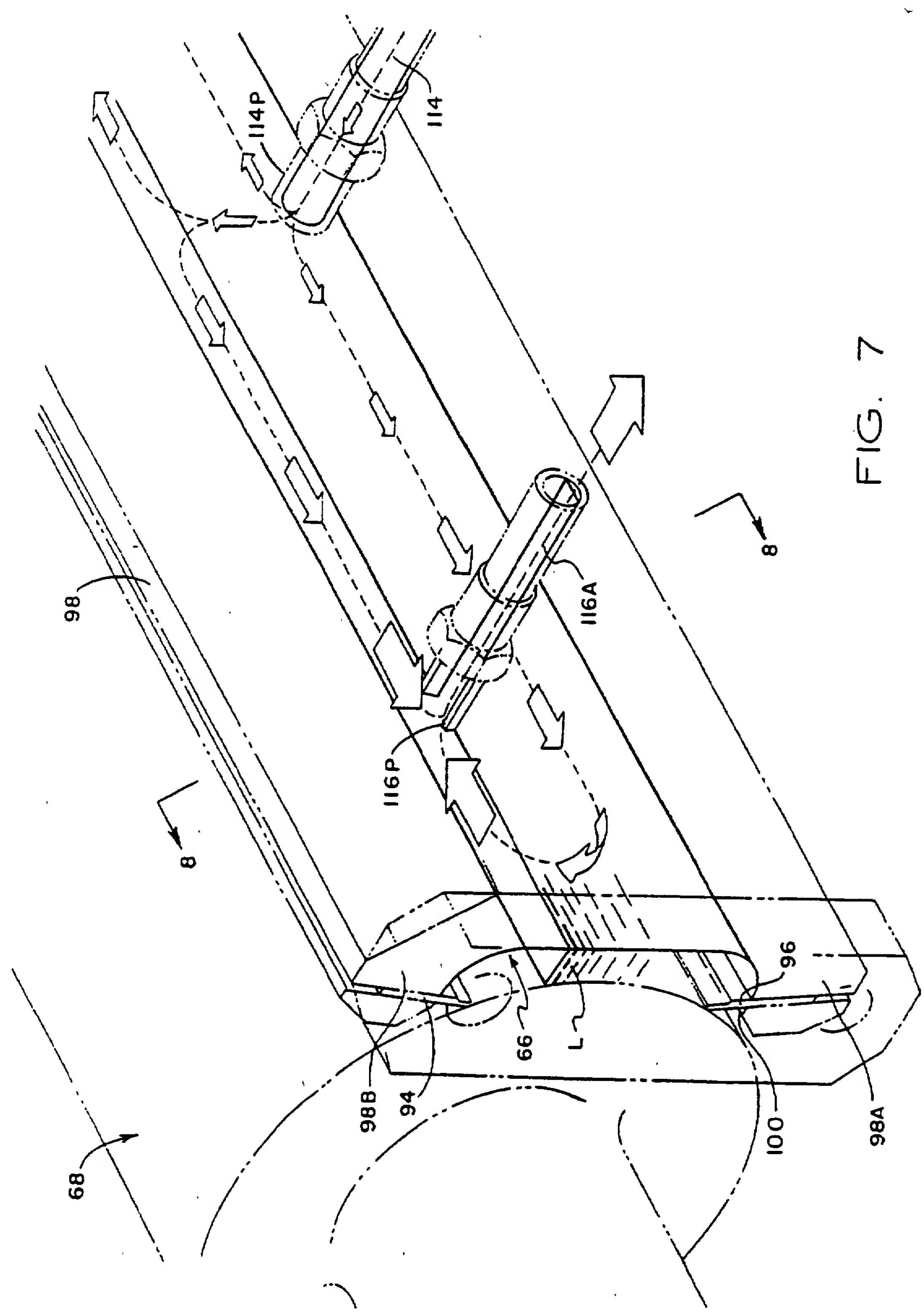


FIG. 7

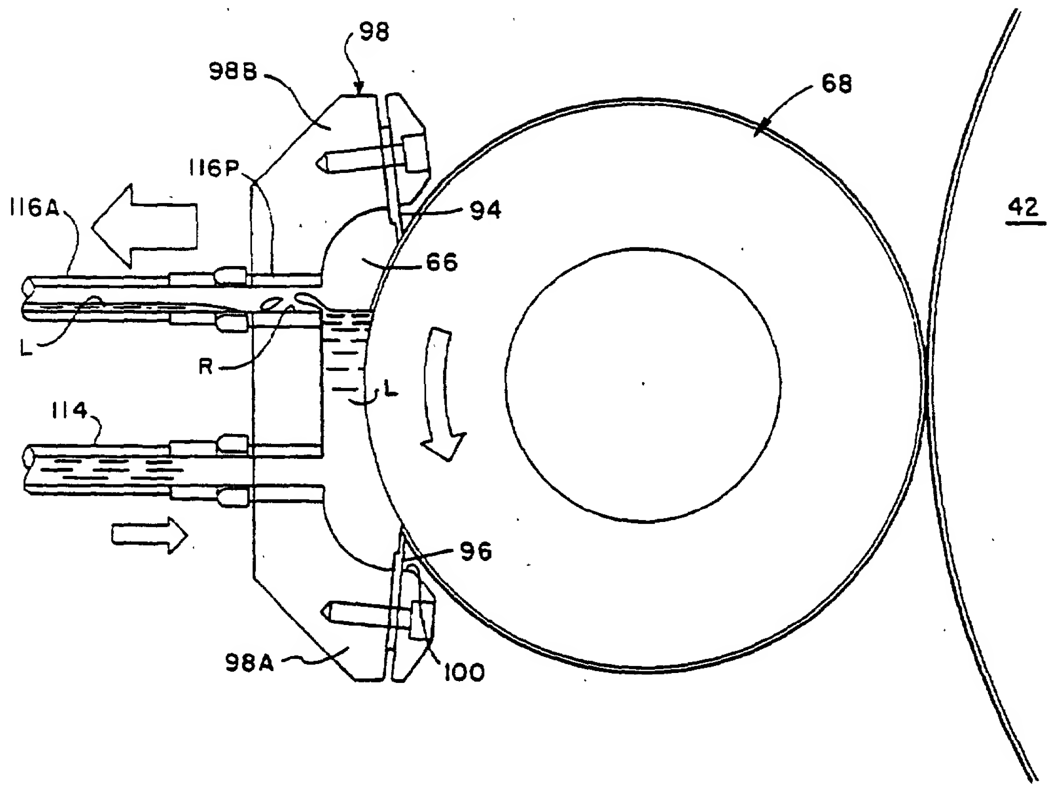
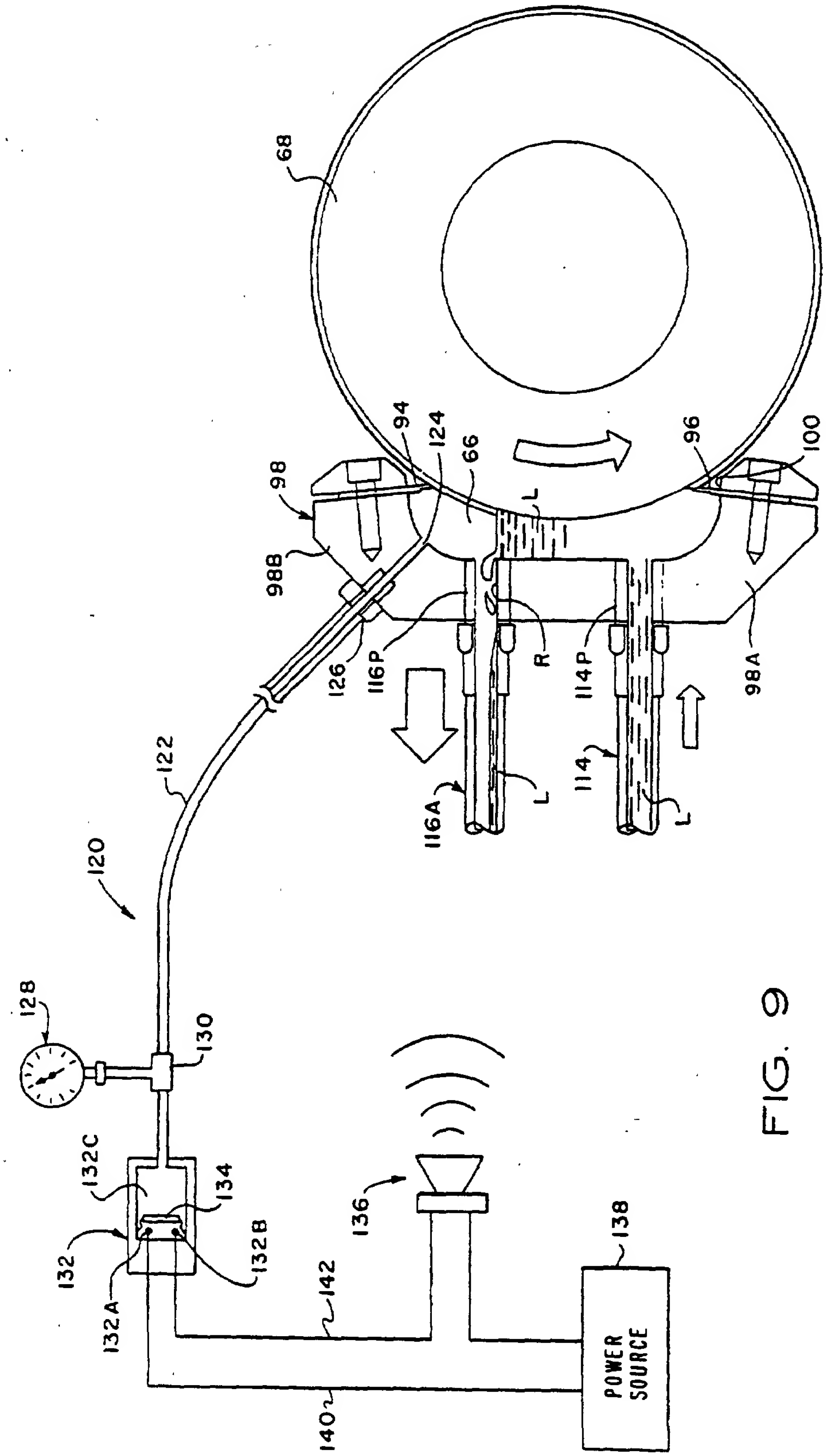


FIG. 8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114P
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116A
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L
120
128
130
132C
134
136
138
132
132B
132A
142
POWER SOURCE
140

FIG. 9

COATING APPARATUS FOR SHEET-FED, OFFSET ROTARY PRINTING PRESSES

CROSS REFERENCE TO RELATED APPLICATION

This is a continuation of application Ser. No. 07/879,841, filed May 6, 1992 now U.S. Pat. No. 5,207,159 which is a continuation-in-part of application Ser. No. 07/752,778 filed Aug. 30, 1991 now U.S. Pat. No. 5,176,077.

FIELD OF THE INVENTION

This invention relates to sheet-fed or web-fed, offset rotary or flexographic printing presses, and more particularly, to a new and improved apparatus for the in-line application of protective and decorative coatings or inks to the printed surface of freshly printed sheets or web.

BACKGROUND OF THE INVENTION

Conventional sheet-fed, offset rotary printing presses typically include one or more printing stations through which individual sheets are fed and printed with wet ink. After final printing, the sheets are fed by a delivery conveyor system to the delivery end of the press where the freshly printed sheets are collected and stacked. In a typical sheet-fed, offset rotary printing press such as the Heidelberg Speedmaster line of presses, the delivery conveyor system includes a pair of endless gripper chains carrying spaced laterally disposed gripper bars and grippers which are used to grip and pull freshly printed sheets from the impression cylinder and convey the sheets toward the sheet delivery stacker. The gripper chains are driven in precisely timed relation to the impression cylinder by gripper chain sprocket wheels which are laterally spaced between a delivery drive shaft mounted on opposite sides of the press frame. The delivery drive shaft is mechanically coupled by gears for synchronous rotation with the impression cylinder.

Since the inks used with offset type printing presses typically remain wet and tacky for some time after printing, special precautions must be taken to insure that the wet inked surface of the freshly printed sheets is not marked or smeared as the sheets are transferred from one printing station to another, and through the delivery system to the sheet delivery stacker. The printed surface of the paper dries relatively slowly and can be smeared during subsequent processing, particularly when the printed sheets are stacked. In order to minimize smearing, a dryer may be mounted along the delivery path of the printed sheets, or an anti-offset spray powder may be sprayed on the printed surface.

In some printing applications, it is desirable that the press be capable of applying a protective and/or decorative coating over all or a portion of the surface of the printed sheets. Typical coating solutions include varnish, lacquer, dye, moisturizers and ink. Such coatings typically are formed of a UV-curable or water-soluble resin applied as a liquid solution or emulsion by an applicator roller over the freshly printed sheets to protect the ink and improve the appearance of the sheets. Use of such coatings is particularly desirable when decorative or protective finishes are required such as in the production of posters, record jackets, brochures, magazines, folding cartons and the like. In cases where a liquid coating is to be applied, the coating operation is

carried out after the final ink printing has been performed, most desirably by an in-line coating application.

DESCRIPTION OF THE PRIOR ART

Various suggestions have been made for applying the coating as an in-line press operation by using the final printing station of the press as the coating application station. For example, in U.S. Pat. Nos. 4,270,483, 4,685,414 and 4,779,557, there are disclosed coating apparatus which can be moved into position to allow the blanket cylinder of the last printing station of a press to be used to apply a coating material to the sheets In U.S. Pat. No. 4,796,556, there is disclosed a coating apparatus which can be selectively moved between the blanket cylinder or the plate cylinder of the last printing station of the press so that the station can be used as a coating station for the press.

Suggestions for overcoming the problem of the loss of a printing station when coating is desired have also been made, such as that set forth in U.S. Pat. No. 4,934,305 which discloses a coating apparatus having a separate timed applicator roller positioned to apply the coating material to the printed sheet while the sheet is on the last impression cylinder of the press. This is said to allow the last printing station to be operated simultaneously as both an ink application station and a coating station so that no loss of press printing unit capability results. Another approach to providing a coating station without losing the printing capabilities of the last printing station is to provide a totally separate coating unit downstream of the last printing station so that the coating is applied to the sheets after final printing and before the sheets have reached the sheet delivery stacker. Such an approach is suggested in U.S. Pat. Nos. 4,399,767 and 4,706,601.

Conventional coating apparatus which is operable as an in-line press operation utilizes an engraved transfer roller, with the liquid coating being applied to the engraved roller by means of a doctor blade assembly. The doctor blade assembly includes an elongated housing having a reservoir chamber extending the length of the transfer roller for holding a volume of coating liquid in wetting contact with the circumferential surface of the transfer roller. A pair of circumferentially spaced doctor blades extend longitudinally along the reservoir housing on either side of the chamber. The doctor blades are angled tangentially toward the transfer roller surface, and seal the reservoir chamber against the roller surface and wipe the roller surface to deposit liquid in the cells of the engraved transfer surface.

The reservoir chamber is pressurized with coating liquid, which is pumped from a remote supply drum into the upper region of the pressure chamber. After the pressure chamber fills to a certain level, it is returned to the remote drum by gravity flow. Occasionally, the doctor blade reservoir chamber becomes completely filled with the coating liquid when the volume of coating liquid being delivered to the doctor blade reservoir chamber exceeds the gravity flow return rate. The positive pressure may cause the seals at the ends of the roller to leak, allowing the coating liquid to drip onto the floor or onto adjacent press parts. Occasionally, the coating liquid may be slung from the roller onto adjacent press equipment and operator areas. Moreover, the buildup of positive pressure within the doctor blade reservoir chamber accelerates the wear of the end seals.

It will be appreciated that the transfer roller may be operated at high speeds, for example, on the order of

1,000 linear feet per minute, and that the end seals of the doctor blade assembly will tend to wear quickly. The end seal wear is accelerated by the buildup of positive pressure within the doctor blade chamber. Low volume drip leakage can be collected in a drip pan or catch tray, but as the end seals wear, the coating liquid will be slung from the transfer roller, thereby causing a difficult cleanup problem. When this occurs, the press must be shut down, the doctor blade head must be removed, and the end seals replaced. The steps of rebuilding or replacing the end seals and realigning the doctor blade head causes an unacceptable amount of press downtime.

One approach for overcoming the problem of end seal wear is to provide stationary end seals which are mounted on the press frame, and which bear in sealing engagement against the ends of the transfer roller, so that the doctor blade head may form a seal with stationary seals rather than with the dynamic seals carried on the transfer roller. Another approach is to use rotary end seals which include an end plate which is resiliently engaged against the end surface of the transfer roller, with a seal member being secured between the end plate and the end portions of the roller by quick removal mounting lugs.

While the foregoing mechanical approaches to limiting end seal wear and thereby avoiding leakage have been moderately successful, and some arrangements have reduced downtime by quick change mounting features, the end seals nevertheless are still experiencing accelerated wear and early failure, thereby causing frequent replacements and unacceptable downtime for correction of end seal leakage.

OBJECTS OF THE INVENTION

Accordingly, there exists a need for a new and improved in-line coating apparatus for use in a sheet-fed or web-fed, offset rotary or flexographic printing press for applying a protective and/or decorative coating to the printed surface of freshly printed sheets which does not require any expensive or substantial press modification or result in any impairment of normal press operating capability.

Specifically, the principal object of the present invention is to provide a new and improved in-line coating and/or inking apparatus of the character described which achieves a reduction in end seal leakage.

SUMMARY OF THE INVENTION

The present invention provides a new and improved in-line doctor blade apparatus for applying a protective and/or decorative coating and/or inking to the surface of freshly printed sheets in a sheet-fed or web-fed, offset rotary or flexographic printing press which is highly reliable and effective in use, yet which does not require any expensive or substantial press modification or result in any impairment of normal press operating capability.

The reservoir of a doctor blade head is supplied with coating material from a remote supply drum. To insure that an adequate supply of coating liquid is always present within the doctor blade reservoir, the coating material is drawn from the remote supply drum and is circulated by suction flow constantly through the reservoir. In contrast to the conventional approach of positively pressurizing the doctor blade reservoir with liquid coating pumped from the remote drum to the reservoir, the coating material is instead circulated through the reservoir by suction flow. That is, instead of charging the reservoir with coating liquid pumped from the remote drum and thereby creating a positive pressure condition within the doctor blade reservoir, circulation through the reservoir is induced by suction flow provided by a suction pump having an input connected for drawing coating liquid from the doctor blade reservoir, and returning it by forced (positive pressure) flow to the remote supply drum, rather than by gravity flow return.

As a result of the suction flow arrangement, the liquid material is drawn from the remote supply drum at a greater rate than the rate of withdrawal of the liquid material by the pickup roller, and a substantially constant supply of liquid material will always be present within the doctor blade reservoir. A benefit of the suction flow arrangement is that a positive pressure buildup does not occur within the doctor blade chamber. Moreover, liquid material which rises above a predetermined fill level is drawn out of the doctor blade reservoir by the suction pump, and is returned to the remote drum. Consequently, the end seals are not subjected to high pressure differential conditions. Instead, the suction flow arrangement produces a negative pressure differential, with the doctor blade chamber being operated at a level below atmospheric. Under negative pressure conditions, leakage of coating liquid is virtually nonexistent, and the operating life of the end seals is substantially increased.

According to another aspect of the present invention, visual and audible alerts are provided by a vacuum sensor line which is coupled to the vacuum space within the doctor blade chamber. The sensor line is coupled to a vacuum gauge which provides a visual indication of the suction pressure within the doctor blade chamber. A vacuum sensor switch is also coupled to the chamber for selectively applying electrical power to an audio transducer when the pressure within the vacuum chamber rises above a predetermined safe operating suction level.

Other features and advantages of the present invention will become more apparent from the following detailed description taken in conjunction with the accompanying drawings which disclose, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side elevational view of a sheet-fed, offset rotary printing press having a coating apparatus embodying the present invention;

FIG. 2 is an enlarged fragmentary side elevational view taken substantially within the circular area designated "2" in FIG. 1 and showing the coating apparatus of the present invention during coating operation;

FIG. 3 is an enlarged fragmentary perspective view showing one side of the coating apparatus mounted in the press and illustrating the fluid path of coating material from a remote supply drum to the doctor blade reservoir of the coating unit;

FIG. 4 is an enlarged fragmentary sectional view taken substantially along the line 4—4 of FIG. 3;

FIG. 5 is a simplified flow diagram which illustrates a dual pump arrangement for circulating coating liquid from a remote supply drum to the doctor blade reservoir and return;

FIG. 6 is a simplified flow diagram which illustrates a single pump arrangement for circulating coating liquid by suction flow from a remote supply drum to the doctor blade reservoir and return;

FIG. 7 is an enlarged fragmentary perspective view of one end portion of the doctor blade coating apparatus of the present invention;

FIG. 8 is an enlarged sectional view taken substantially along the line 8—8 of FIG. 7; and,

FIG. 9 is a view similar to FIG. 8 which includes a suction pressure sensing circuit for providing a visual indication of suction pressure and an audible alert when the suction/vacuum pressure inside the doctor blade rises above a safe operating level, thereby signaling an impending end seal failure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the exemplary drawings, the present invention is embodied in a new and improved in-line doctor blade apparatus, herein generally designated **10**, for use in applying a protective and/or decorative coating or inks to the freshly printed surface of sheets printed in a sheet-fed or web-fed, offset rotary or flexographic printing press, herein generally designated **12**. In this instance, as shown in FIG. **1**, the doctor blade coating apparatus **10** is illustrated as installed in a four color printing press **12**, such as that manufactured by Heidelberger Druckmaschinen AG of the Federal Republic of Germany under its designation Heidelberg Speedmaster 102V (40"), and which includes a press frame **14** coupled at one end, herein the right end, with a sheet feeder **16** from which sheets, herein designated **18**, are individually and sequentially fed into the press, and at the opposite end, with a sheet delivery stacker **20** in which the finally printed sheets are collected and stacked. Interposed between the sheet feeder **16** and the sheet delivery stacker **20** are four substantially identical sheet printing stations **22, 24, 26** and **28** which can print different color inks onto the sheets as they are moved through the press **10**.

As illustrated, each of the printing stations **22, 24, 26** and **28** is substantially identical and of conventional design, herein including a sheet-fed cylinder **30**, a plate cylinder **32**, a blanker cylinder **34** and an impression cylinder **36**, with each of the first three printing stations **22, 24** and **26** having a transfer cylinder **38** disposed to withdraw the freshly printed sheets from the adjacent impression cylinder and transfer the freshly printed sheets to the next printing station via a transfer drum **40**. The final printing station **28** herein is shown as equipped with a delivery cylinder **42** which functions to support the printed sheet **18** as it is moved from the final impression cylinder **36** by a delivery conveyor system, generally designated **44**, to the sheet delivery stacker **20**.

The delivery conveyor system **44** as shown in FIG. **2** is of conventional design and includes a pair of endless delivery gripper chains **46**, only one of which is shown carrying at regular spaced locations along the chains, laterally disposed gripper bars **48** having gripper elements **50** used to grip the leading edge of a sheet **18** after it leaves the nip between the delivery cylinder **42** and impression cylinder **36** of the last printing station **28**. As the leading edge E of the sheet **18** is gripped by the grippers **50**, the delivery chains **46** pull the sheet away from the imprèssion cylinder 36 and convey the freshly printed sheet to the sheet delivery stacker **20** where the grippers release the finally printed sheet.

The endless delivery chains **46** are driven in synchronous timed relation to the impression cylinder **36** by sprocket wheels **52** fixed adjacent the lateral ends of a delivery drive shaft **54** which has a mechanically geared coupling (not shown) to the press drive system. The delivery drive shaft **54** extends laterally between the sides of the press frame **14** adjacent the impression cylinder **36** of the last printing station **28**, and is disposed to be parallel with the axis of the impression cylinder. In this instance, the delivery cylinder **42**, which is constructed to allow adjustments in diameter by suitable means, is attached to the delivery drive shaft **54** so that the delivery cylinder is also rotated in precise timed relation with the impression cylinder.

In this respect, it is important to note that when the freshly printed sheets **18** are conveyed away from the impression cylinder **36** of the final printing station **28** by the gripper **50** carried by the delivery chains **46**, the wet inked surfaces of the sheets face the delivery drive shaft **54** and the sheets must be supported such that the ink is not smeared as the sheets are transferred. Typically, such support is provided by skeleton wheels or cylinders mounted to the press delivery drive shaft **54**, or as is now more commonly used, net equipped delivery cylinders marketed by Printing Research, Inc. of Dallas, Tex. under its registered trademark SUPERBLUE. That system, which is made and sold under license, is manufactured in accordance with and operates as described in U.S. Pat. No. 4,402,267, issued Sep. 6, 1983, to Howard W. DeMoore, the disclosure of which is incorporated herein by this reference.

More recently, vacuum transfer apparatus of the type disclosed in co-pending application Ser. No. 07/630,308, filed Dec. 18, 1990, entitled "Vacuum Transfer Apparatus for Sheet-Fed Printing Presses", which is also incorporated herein by reference, has been used. The vacuum transfer apparatus disclosed in that application can be used in place of delivery cylinders or skeleton wheels to pull the unprinted side of the sheet away from the delivery drive shaft **54** so that the wet ink surface of the sheets do not come into contact with any press apparatus.

In accordance with the present invention, the in-line doctor blade coating apparatus **10** for applying the protective or decorative coating or ink to the sheets **18** enables the press **12** to be operated in the normal manner without the loss of the final printing station **28**, and without requiring any substantial press modifications by employing the existing press delivery drive shaft **54** as the mounting location for the coating applicator roller. In presses having delivery systems such as skeleton wheels mounted on the delivery drive shaft **54** or a vacuum transfer apparatus as disclosed in the aforementioned co-pending application Ser. No. 07/630,308, conversion to a coating operation can be quickly and easily achieved by mounting on the press delivery drive shaft in place of the skeleton wheels or in addition to the vacuum transfer apparatus, a suitable support cylinder capable of performing the combined function of a coating applicator roller and a net enhanced delivery cylinder **42**. By utilizing the delivery cylinder **42** mounted on the delivery drive shaft **54** to also act as a coating applicator roller, protective coating will be applied to the printed sheet **18** in precise timed registration, and will permit the press to be operated with its full range of printing stations.

Toward these ends, the coating apparatus **10** of the present invention includes a relatively simple, positive acting and economical doctor blade coating unit, generally designated **60**, mounted to the press frame **14** downstream of the delivery drive shaft **54** and positioned to apply liquid coating material to the support surface of a

delivery cylinder 42 mounted on the delivery drive shaft. As can best be seen in FIGS. 2, 3 and 4, the doctor blade coating unit 60 herein comprises a pair of side frames 62, only one of which is shown, it being understood that the other side frame is substantially the same as that of the side frame illustrated, attached to each side of the press frame 14. Pivotally mounted to one end of each of the side frames 62 is a support bracket 64 carrying one end of a liquid material reservoir 66 and cooperating liquid material pickup roller 68 each disposed to extend laterally across the press 12 parallel with the delivery drive shaft 54. The coating unit 60 is mounted between the upper and lower runs of the delivery chains 46 downstream of the delivery drive shaft 54, and positioned so that the outer peripheral surface 70 of the pickup roller 68 can be engaged with the support surface of a delivery cylinder 42 mounted on the delivery drive shaft.

As best seen in FIGS. 2 and 3, the support bracket 64 is pivotally attached to the end of the side frame 62 by a shaft 72 disposed at the lower end portion of the bracket, and can be pivoted about the shaft by an extensible cylinder 74, herein shown as a pneumatic cylinder, one end 76 of which is secured such as by welding to the side frame, and the opposite end 78 of which is coupled through a pivot shaft 79 to the upper end portion of the bracket. By extending or retracting the cylinder 74, the extent of engagement of the pickup roller 68 against the surface of the applicator roller 42 can be controlled, and the pickup roller can be completely disengaged from the applicator roller 42.

The coating pickup roller 68, which is of conventional design and preferably one such as the Anilox rollers manufactured by A.R.C. International of Charlotte, N.C. and sold under the name "PRINTMASTER" having an engraved ceramic or chrome outer peripheral surface 70, is designed to pick up a predetermined uniform thickness of liquid coating material or ink from the reservoir 66, and then uniformly transfer the coating material to the support surface of the applicator roller 42. To effect rotation of the pickup roller 68, a suitable motor 80, herein a hydraulic motor, is attached to one of the side frames 62 and coupled to a suitable hydraulic fluid source (not shown) through fittings 81A, 81B. Attached to the output of the motor 80 is an output gear which is drivingly coupled through a cluster gear 82 and a series of idler gears 83 each mounted on stub axles 84, to a drive gear 86 attached to the end of a shaft 88 on which the pickup roller 68 is concentrically mounted. The shaft 88 of the pickup roller 68 is, in turn, journaled at each end to the brackets 64 through a releasable semicircular collar 90 attached by bolts 92 to the bracket. Herein, the axle of the terminal idler gear, designated 83', also serves as the shaft 72 for pivotally mounting the support bracket 64 to the side frame 62 so that when the bracket is rotated about the shaft, the terminal idler gear remains engaged with the drive gear 86 of the pickup roller 68.

In this instance, as can best be seen in FIG. 4. the pickup roller 68 has a peripheral surface portion 68P which projects radially into the reservoir 66 containing the supply of coating material or ink. A pair of upper and lower inclined doctor blades 94 and 96 attached to the doctor blade head 98 on shoulders 98A, 98B engage the roller surface to doctor the excess liquid coating material or ink picked up from the reservoir by the engraved surface 70 of the roller. The reservoir cavity 66 herein is formed within an elongated doctor blade head 98 having a generally C-shaped cross-section with an opening 100 extending longitudinally along one side facing the pickup roller 68. The reservoir 66 is supplied with liquid material or ink from a supply drum 102 disposed in a remote location within or near the press 12. Preferably, the doctor blade head 98 is removably attached to the brackets 64, herein by bolts 104 having enlarged, knurled heads 106, and which can be threaded through slots 108 formed in the brackets to clamp the reservoir in place on the brackets.

To insure that an adequate supply of liquid coating material is always present within the reservoir 66 and to prevent coagulation and clogging of the doctor blades 94 and 96 by the liquid coating material or ink, the coating material or ink is circulated through the reservoir by two pumps 110 and 112 as shown in FIG. 5. Pump 110 draws the liquid material L from the supply drum 102 via a supply line 114 and discharges it into a bottom region of the reservoir 66 through a delivery port 114P, and the other pump 112 acts to provide suction to a pair of return lines 116A, 116B coupled adjacent a top region of the reservoir through return ports 116P, 116Q for withdrawing excess liquid coating material or ink from the reservoir. By supplying the coating material or ink from the supply drum 102 at a greater rate than the rate of withdrawal of material by the pickup roller 68, a substantially constant supply of coating material or ink will always be present within the reservoir 66. The excess coating material or ink which rises above the liquid level of the return port R (FIG. 8) is suctioned away by the suction return pump 112.

The general arrangement of the pickup roller 68, doctor blades 94 and 96, and reservoir 66 is similar to that disclosed in U.S. Pat. No. 4,821,672 entitled "Doctor Blade Assembly With Rotary End Seals and Interchangeable Heads", the disclosure of which provides details concerning the end seal structure and operation of a pickup roller and reservoir usable with the present invention. According to an important feature of the present invention, however, the doctor blade reservoir 66 is not pressurized as taught by the prior art. Instead, coating liquid or ink is supplied to the doctor blade reservoir 66 by the suction flow produced by the pump 112. In this arrangement, the suction pump 112 applies a vacuum or suction force in the reservoir which draws liquid material L from the supply through the supply conduit 114 to the reservoir and draws excess liquid material L from the doctor blade reservoir 66 through the return conduit 116 into the remote reservoir 102 at a rate which is greater than the rate that liquid coating material or ink is being supplied to the doctor blade reservoir through the supply conduit 114. Because the suction return flow rate is greater than the supply flow rate, a positive pressure condition within the doctor blade reservoir is avoided, and a below atmospheric vacuum pressure level is provided.

Referring to FIG. 5, FIG. 6, FIG. 7 and FIG. 8, the liquid material is delivered into the lower region of the doctor blade reservoir 66, and is withdrawn from the doctor blade reservoir near an upper region of the chamber through the return conduits 116A, 116B. The liquid level elevation of the return port is preferably selected to provide for the accumulation of liquid coating material or ink in more than about half of the doctor blade chamber, thereby insuring that the engraved surface of the pickup roller 68 will be thoroughly wetted by the coating material or ink L as it turns through the doctor blade chamber 66. The reservoir 66 is bounded

vertically by lower and upper doctor head shoulders 98A, 98B. Accordingly, the return ports 116P, 116Q of return lines 116A, 116B are located at a liquid level R intermediate the limits established by the lower and upper shoulders. Any excess liquid coating material or ink which rises above the liquid level R of the return ports will be suctioned away by the pump 112.

It will be appreciated that the supply pump 110 is optional, and that the suction circulation system can be operated effectively with only the single suction pump 112 as shown in FIG. 6. In the single pump configuration, it may be necessary to prime the supply conduit 114 to obtain satisfactory operation. The two pump arrangement as shown in FIG. 5 is preferred for those installations in which the supply drum 102 is located at a distance that is too far from the press to achieve adequate suction flow. The auxiliary supply pump 110 provides positive flow input to the doctor blade reservoir at a fixed flow rate. The return suction pump 112 has a faster suction flow rate than the supply flow rate. Consequently, a positive pressure buildup in the doctor blade reservoir cannot occur. By utilizing two pumps as shown in FIG. 5, the liquid level within the doctor blade chamber 66 can be closely controlled, without positive pressure buildup, thereby reducing leakage through the end seals.

Referring to FIG. 8, it will be appreciated that the doctor blade chamber 66 is maintained at a pressure level below atmospheric by the suction action of the return flow pump 112. The coating liquid L rises to the liquid level of the return port R and is drawn off immediately by the suction pump 112. Additionally, air within the doctor blade chamber 66 is also evacuated, thereby reducing the doctor blade chamber pressure to a level below atmospheric. This negative pressure differential condition opposes leakage of coating liquid L through the end seals. Since the doctor blade chamber 66 is not positively pressurized, the end seals are operated under favorable pressure differential conditions, thereby extending their useful lifetime. Moreover, the negative pressure differential doctor blade assembly will accommodate a pickup roller having a chipped corner, which would leak under positive pressure conditions, but does not leak because of the negative pressure reservoir condition established by suction flow.

It is useful for the press operator to have an advance warning of an impending end seal failure. With advance warning, the press operator can schedule repair and/or replacement of the doctor blades and the end seals at a convenient time, for example between press runs or before undertaking the next printing job. Apparatus for monitoring the suction/vacuum condition within the doctor blade chamber 66 is provided by a pneumatic sensor circuit 120 as shown in FIG. 9. The pneumatic sensor circuit 120 includes a pneumatic sensor line 122 which is coupled in fluid communication with the doctor blade chamber 66 through a vacuum sensor bore 124 formed through the upper doctor head shoulder 98B. The vacuum sensor line 122 is coupled to the sensor bore 124 by a threaded fitting 126.

Continuous monitoring of the vacuum/suction condition within the doctor blade chamber 66 is provided by a vacuum gauge 128 which can be of any conventional design, for example a Bourdon gauge which is calibrated for dry air and covers the range from about zero to about twenty torrs. The vacuum gauge 128 is coupled into the sensor line 122 by a tee coupling 130. According to this arrangement, the press operator receives a continuous visual indication of the vacuum/-suction condition within the doctor blade chamber 66.

According to another feature of the invention, the vacuum/suction line 122 is coupled to a vacuum switch 132. The vacuum switch 132 has a conductive, movable diaphragm 134 which moves into and out of electrical contact with switch electrodes 132A, 132B. That is, the diaphragm 134 is pulled out of contacting engagement with the switch electrodes 132A, 132B when the vacuum/suction level in the doctor blade chamber 66 is below a predetermined level. When the pressure level within the doctor blade chamber 66 rises above that preset level, for example in response to leakage of air through the end seals or around a worn doctor blade 94, the vacuum force within the vacuum chamber 132C of the sensor switch also rises, thereby permitting the conductive switch element 134 to engage the switch electrodes 132A, 132B.

When switch closure occurs, electrical power is applied to an audio transducer 136 from a power source 138. Electrical current is conducted through the pneumatic switch 132 to the audio transducer 136 through power conductors 140, 142. According to this arrangement, the press operator will receive an audible alert as soon as the suction/vacuum pressure in the doctor blade chamber rises above a safe operating level, thereby signaling wear failure of the doctor blades and-/or an impending failure of the end seals.

From the foregoing, it should be apparent that the coating apparatus 10 of the present invention provides a highly reliable, effective and economical in-line apparatus for applying coating material to the freshly printed sheets 18 in a sheet-fed, offset rotary printing press 12 which allows the final printing station to continue to be used as a print station, yet which does not require any substantial press modification or the addition of a separate timed applicator roller. While a particular form of the present invention has been illustrated and described, it should be apparent that variations and modifications therein can be made without departing from the spirit and scope of the invention.

What is claimed is:

1. Coating apparatus for applying liquid material from a supply drum to an applicator roller which is engagable in an operative position with a doctor blade head having an elongated reservoir for receiving liquid material from the supply drum, said doctor blade head being adapted to extend in parallel with the applicator roller in the operative position with a portion of the peripheral surface of the applicator roller extending into said reservoir for wetting contact with liquid material contained therein, characterized in that:

seal means are coupled to the doctor blade head for sealing engagement against the applicator roller in the operative position, whereby the doctor reservoir is sealed with respect to atmospheric pressure; and,

circulation means are coupled to the doctor reservoir for inducing the flow of liquid material from said supply drum into the doctor reservoir, for returning liquid material by suction flow from the doctor reservoir to the supply drum, and for maintaining the doctor reservoir at a pressure level below atmospheric pressure.

2. Coating apparatus as defined in claim 1, said circulation means being characterized by

a supply conduit connecting the supply drum in flow communication with the doctor reservoir;

a return conduit connecting the doctor reservoir in flow communication with the supply drum; and,

a first pump coupled in series flow relation with the return conduit for inducing suction flow of liquid material from the doctor reservoir through the return conduit into the supply drum.

3. Coating apparatus as defined in claim 2, characterized in that the return conduit is coupled in flow communication with the doctor reservoir at a first liquid level location and the supply conduit is coupled in flow communication with the doctor reservoir at a second liquid level location, the first liquid level location of the return conduit being higher in elevation than the second liquid level location of the supply conduit when the doctor blade head is in the operative position.

4. Coating apparatus as defined in claim 1, said circulation means being characterized by:

a second pump coupled in series flow relation with said supply conduit for pumping liquid material from the supply drum to the doctor reservoir.

5. Coating apparatus as defined in claim 4, characterized in that the suction return flow rate provided by said first pump is greater than the supply flow rate provided by said second pump.

6. Coating apparatus as defined in claim 1, wherein the doctor blade head having first and second shoulders forming lower and upper liquid level boundaries for said reservoir, respectively, characterized in that said circulation means includes a return conduit coupled in flow communication with said reservoir at a liquid level location disposed intermediate the liquid level boundaries established by said first and second shoulders.

7. Coating apparatus as defined in claim 1, characterized in that a pneumatic conduit is coupled to the doctor reservoir for sensing air vacuum pressure within the doctor reservoir, and a vacuum gauge is coupled to the pneumatic conduit for providing a visual indication of air vacuum pressure in the doctor reservoir.

8. Coating apparatus as defined in claim 1, characterized in that a pneumatic conduit is coupled to the doctor reservoir for sensing air vacuum pressure within the doctor reservoir, a vacuum responsive switch having switch electrodes is coupled to said pneumatic sensor conduit, and an audio transducer is electrically connected to the switch electrodes for making and breaking an electrical circuit from a power source to said audio transducer.

9. Coating apparatus as defined in claim 1, characterized in that means are coupled to the doctor reservoir for supplying and evacuating liquid material to and from the doctor reservoir at differential flow rates, respectively, whereby a lower chamber region of the doctor reservoir is maintained in a filled condition and an upper chamber region of the reservoir is maintained in an evacuated condition.

10. Coating apparatus for applying liquid material from a supply drum to an applicator roller which is engagable in an operative position with a doctor blade head having an elongated reservoir for receiving liquid material from the supply drum, said doctor blade head being adapted to extend in parallel with the applicator roller in the operative position with a portion of the peripheral surface of the applicator roller extending into said reservoir for wetting contact with liquid material contained therein, and including doctor blade means attached to the doctor blade head for engagement against the peripheral surface of the applicator roller in the operative position, characterized in that:

circulation means are coupled to the doctor reservoir for inducing the flow of liquid material from said supply drum into the doctor reservoir and for returning liquid material by suction flow from the doctor reservoir to the supply drum; and

means are provided for mounting the coating apparatus on the side frame of a printing press adjacent to a transfer delivery cylinder, a liquid material coating blanket is secured to the transfer delivery cylinder, and including means for extending the applicator roller into engagement with the coating blanket in the operative position and for retracting the applicator roller out of engagement with the coating blanket in an idle position.

* * * * *

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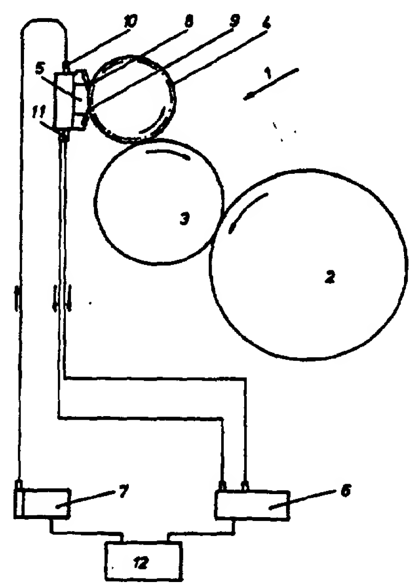
(54) **Einrichtung zum Beschichten von Bedruckstoffen in Druckmaschinen**

(57) Die Erfindung betrifft eine Einrichtung zum Beschichten von Bedruckstoffen in Druckmaschinen zum Auftragen höherviskoser Flüssigkeiten auf Wasserbasis. Aufgabe der Erfindung ist es, eine dementsprechende Einrichtung für Druckmaschinen zu entwickeln, die eine Inlineverarbeitung von höherviskosen Flüssigkeiten mit einer Viskosität von etwa 0,1 bis 2 Pa s gestattet. Gelöst wird die Aufgabe dadurch, daß einem eine Hochdruckform tragenden Formzylinder (3) ein Druckzylinder (2) zugeordnet ist, eine Auftragwalze (4) mit Rasterstruktur dem Formzylinder (3) zugeordnet ist und gleichzeitig der Auftragwalze (4) ein Kammerrakel (5) zugeordnet ist. Das Kammerrakel (5) besteht aus einem positiven Rakel (8) und einem negativen Rakel (9) sowie Seitenteilen. Über eine Förderpumpe (7) wird höherviskose Flüssigkeit dem Kammerrakel (5) zugeführt, in dem Innenraum des Kammerrakels (5) wird ein Überdruck aufgebaut, die höherviskose Flüssigkeit fließt über Flüssigkeitsabläufe (11) ab und wird einer Saugpumpe (6) mit Reservoir (12) zugeführt.



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Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

W019703

Beschreibung

Die Erfindung betrifft eine Einrichtung zum Beschichten von Bedruckstoffen in Druckmaschinen, speziell zum Auftragen von höherviskosen, wasserverdünnbaren, als effekt- und/oder schutzlackwirkenden Schichten definierter Dicke auf den Bedruckstoff.

Aus der DE 30 46 257 C2 ist eine Einrichtung mit einem Lackvorratsbehälter und einer Schöpfwalze bekannt. Der durch die Schöpfwalze aufgenommene Lack wird dosiert einer Auftragwalze zugeführt. Zwei Rakelwalzen sind an die Schöpfwalze anstellbar und an die Dosierwalze ist ein Rakelblatt zum Abstreifen der Lackmenge anstellbar.

Ein Auftragswerk für hochviskose, ölhaltige oder niedrigviskose wasserlösliche Schichten ist aus der DE 39 06 648 A1 bekannt. Dieses Auftragswerk ist als Lackiereinrichtung, wahlweise als Offset-Hochdruck- oder Tiefdruckwerk ausgebildet. Die Ausführungen gehen von einer strukturierten Schöpfwalze aus, die mit einem Rakelblatt korrespondierend bzw. von einer Auftragwalze und einem strukturierten Formzylinder, der mit einem Rakelblatt korrespondiert. Das Hochdruckwerk besteht dabei aus einer mit Näpfchen profilierten Schöpfwalze, der ein Rakelblatt zugeordnet ist, einer Übertragwalze, der Glättwalzen zugeordnet sind und einem Formzylinder mit Hochdruckform.

Gemäß der DE 34 27 898 C1 ist eine Vorrichtung zum Dosieren von Lack über einen zwischen zwei Walzen gebildeten Lackspalt bekannt.

Nachteilig bei diesen Lösungen ist es, daß bei Verarbeitung von Flüssigkeiten mit höherer Viskosität, ca. 0,1 bis 2 Pa·s Probleme auftreten, da die Flüssigkeiten eine Fließgrenze aufweisen. Es kommt zu Störungen der Flüssigkeitsströmungen, die z. B. zu sogenannten Lacknestern führen, in denen der Lack leicht antrocknet.

Beispielsweise aus der DE 36 14 582 A1 ist ein sogenanntes Kammerrakel zum Auftragen einer Beschichtungsmasse auf eine Beschichtungswalze bekannt. Mindestens zwei, an einer Walze anliegende, Rakelblätter bilden eine Kammer zur Aufnahme einer Masse, die unter Druck zugeführt wird.

Nachteilig ist, daß die unter Druck zugeführte Masse lediglich über dem Rakelspalt austreten kann und über einen weiteren druckfreien Raum eine Rückführung des Überschusses erfolgt. Bei Verwendung von höherviskosen Flüssigkeiten können sich an den Rakelblättern Ablagerungen aufbauen, die zu Druckstörungen führen.

Aufgabe der Erfindung ist es, eine Beschichtungseinrichtung für Druckmaschinen zu entwickeln, die eine problemlose Inline-Verarbeitung von schnellverdunstenden Flüssigkeiten mit einer Viskosität von etwa 0,1 bis 2 Pa·s und speziellen Zusammensetzungen mit hohem Pigmentanteil bzw. groben Pigmenten gestattet.

Gelöst wird die Aufgabe durch den kennzeichnenden Teil des Hauptanspruches. Weiterbildungen ergeben sich aus den Unteransprüchen.

Die erfindungsgemäße Lösung gestattet es, das Inline-Beschichten mit höherviskosen Flüssigkeiten in einer Druckmaschine vorzunehmen unter besonderer Berücksichtigung von Lacken bzw. pigmentierten Farben auf Wasserbasis (Metallglanzdrucke). Einsatzgebiete bestehen für ausgespartes Lackieren (Spotlackierung) oder vollflächiges Lackieren. Aufgrund der geschlossenen Kammer beim Kammerrakel wird die Verdunstung der verwendeten Flüssigkeit reduziert. Dadurch wird die Verarbeitung von schnell verdunstenden, z. B. wasserlöslichen Flüssigkeiten verbessert. Die Kammerrakel verhindert weiterhin das von offenen Rakelblattausführungen bzw. Schöpfwalzenausführungen bekannte Lack- bzw. Farbspritzen. Ebenso wird das mögliche Aufbauen von angetrockneten Lack-/Farbresten an der Rakelschneide verhindert. Durch das geschlossene Flüssigkeitstransportsystem stellt die erfindungsgemäße Einrichtung einen Funktionsbaustein dar. Neben Kombinationen von mindestens einem Offsetdruckwerk und mindestens einem Flexodruckwerk kann diesen Einrichtungen eine weitere Lackiereinrichtung, z. B. zum vollflächigen Lackieren, nachgeordnet sein.

Die Erfindung soll an einem Ausführungsbeispiel näher erläutert werden. Dabei zeigt

Fig. 1 die schematische Darstellung einer Einrichtung zum Beschichten.

Die in Reihenbauweise ausgeführte Druckmaschine besteht aus fünf Offsetdruckwerken, einer Beschichtungseinrichtung 1 und einer nachgeordneten herkömmlichen Lackiereinheit. Dabei kann die Beschichtungseinrichtung 1 als Spotlackiereinrichtung (für ausgespartes Lackieren) und die nachgeordnete Lackiereinheit zum vollflächigen Oberflächenfinishing eingesetzt werden.

Die erfindungsgemäße Beschichtungseinrichtung 1 besteht aus einem Druckzylinder 2, dem bogenführende Zylinder (nicht gezeigt) vor- bzw. nachgeordnet sind. Der Druckzylinder 2 ist in Kontakt mit einem Formzylinder 3, der eine eingespannte flexible Hochdruckplatte trägt. In Kontakt mit dem Formzylinder 3 ist eine, als Lackwalze wirkende Auftragwalze 4, die eine strukturierte Oberfläche mit Rasternäpfchen besitzt. An die Auftragwalze 4 anstellbar ist dieser ein Kammerrakel 5 zugeordnet, welches ein positives Rakel 8 und ein negatives Rakel 9 und abschließende Seitenteile besitzt, so daß zur Auftragwalze 4 eine offene Kammer gebildet wird. Das positive Rakel 8 zeigt in Drehrichtung der Auftragwalze 4 und wirkt als Schließrakel. Das negative Rakel 9 zeigt entgegen der Drehrichtung der Auftragwalze 4 und wirkt als Arbeitsrakel. Das Kammerrakel 5 besitzt an seinem Gehäuse einen oberhalb einspeisenden Flüssigkeitszulauf 10, der mittig angeordnet ist. Am Gehäuseunterteil des Kammerrakels 5 sind zwei austretende Flüssigkeitsabläufe 11 im Bereich der Seitenteile angeordnet. Der Flüssigkeitszulauf 10 ist mit einer Förderpumpe 7 und einer Leitung gekoppelt. Die Flüssigkeitsabläufe 11 führen über Leitungen zu einer Saugpumpe 6. Eine speziell durch die Pigmentierung höherviskose Flüssigkeit z. B. auf Wasserbasis, wie z. B. Gold- und Silberdruckfarbe, Deckweiß oder Lack, wird durch die Förderpumpe 7 über eine Leitung und den Flüssigkeitszulauf 10 in die Gehäusekammer der Kammerrakel 4 gefördert. Der Förderdruck der Pumpe 7 bildet im Inneren des Kammerrakels 5 einen Überdruck aus, aufgrund dessen die höherviskose Flüssigkeit das Innere des Kammerrakels 5 in Richtung Auftragwalze und durch die Flüssigkeitsabläufe 11 verlassen soll. Von den Abläufen 11 wird die Flüssigkeit durch die Saugpumpe 6 in ein Reservoir 12 zurückgefördert. Über die Rasternäpfchen der Auftragwalze 4 wird die höherviskose Flüssigkeit von der als Lackwalze wirkenden Auftragwalze 4 zum Einfärben der Hochdruckform auf den Formzylinder 3 transportiert und wird als Schicht auf den vom Druckzylinder 2 zugeführten Bedruckstoff aufgebracht. Während des von der Auftragwalze 4 bewirkten Flüssigkeitstransports rakelt das negative Rakel 9 die Flüssigkeit von den Stegen der Rasternäpfchenstruktur der Auftragwalze 4 ab, so daß die Flüssigkeit ausschließlich in den Rasternäpfchen verbleibt.

W019704

Bezugszeichenliste

1 Einrichtung
2 Druckzylinder
3 Formzylinder
4 Auftragwalze
5 Kammerrakel
6 Saugpumpe
7 Förderpumpe
8 positives Rakel
9 negatives Rakel
10 Flüssigkeitszulauf
11 Flüssigkeitsablauf
12 Reservoir

Patentansprüche

1. Einrichtung vorzugsweise in Bogenrotationsdruckmaschinen für mehrfarbigen Offsetdruck zum Beschichten von Bedruckstoffen mit wenigstens einem Lackierwerk, **dadurch gekennzeichnet**, daß wenigstens ein Beschichtungswerk als Flexodruckwerk ausgebildet ist.

2. Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß dem Flexodruckwerk ein konventionelles Lackierwerk direkt oder indirekt nachgeordnet ist.

3. Einrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß im Flexodruckwerk als Rakeleinrichtung ein Kammerrakel vorgesehen ist.

4. Einrichtung nach Anspruch 1 und 2, dadurch gekennzeichnet, daß das Flexodruckwerk aus folgenden Elementen besteht:
einem, eine Hochdruckform tragenden Formzylinder (3), der mit einem Druckzylinder (2) in Kontakt steht,
einer Auftragwalze (4) mit Rasterstruktur, die mit dem Formzylinder (3) in Kontakt steht und
einem Kammerrakel (5), dessen positives Rakel (8) in Drehrichtung der Auftragwalze (4) an diese angestellt ist und dessen negatives Rakel (9) entgegen der Drehrichtung der Auftragwalze (4) an diese angestellt ist, wobei eine Förderpumpe (7) Leitungssystemen mit Reservoir (12) vorgeordnet und eine Saugpumpe (6) Leitungssystemen mit Reservoir (12) dem Kammerrakel (5) nachgeordnet sind.

5. Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Kammerrakel (5) mit Leitungssystem, Förderpumpe (7) und Saugpumpe (6) ein geschlossenes System bilden, in dem zwischen Förderpumpe (7) und Saugpumpe (6) ein gemeinsames Reservoir (12) angeordnet ist.

6. Einrichtung nach Anspruch 1 und 2, dadurch gekennzeichnet, daß die Einrichtung (1) als Funktionsbaustein in einer Offsetdruckmaschine den Offsetdruckwerken vorgeordnet ist.

7. Einrichtung nach Anspruch 1 und 2, dadurch gekennzeichnet, daß die Einrichtung (1) als Funktionsbaustein in einer Offsetdruckmaschine zwischen den Offsetdruckwerken angeordnet ist.

8. Einrichtung nach Anspruch 1 und 2, dadurch gekennzeichnet, daß die Einrichtung (1) als Funktionsbaustein in einer Offsetdruckmaschine den Offsetdruckwerken nachgeordnet ist.

Hierzu 1 Seite(n) Zeichnungen

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Offenlegungstag: 13. Oktober 1994

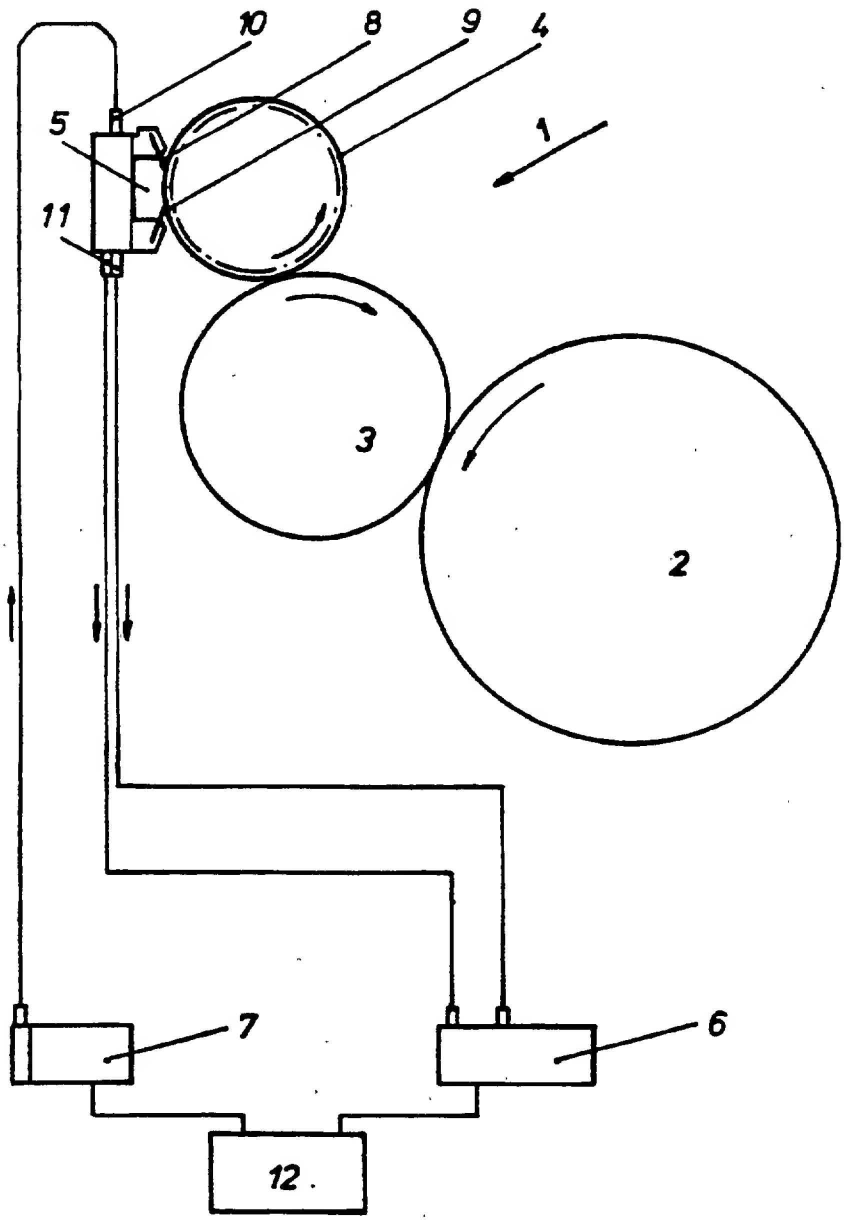

FIG.1

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US005476041A

United States Patent [19]

Czotscher

[11] Patent Number: 5,476,041
[45] Date of Patent: Dec. 19, 1995

[54] **PRINTING PRESS HAVING A DEVICE FOR CONTROLLING THE AIR IN A SHEET FEEDER**

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[73] Assignee: **Heidelberger Druckmaschinen Aktiengesellschaft**, Heidelberg, Germany

[21] Appl. No.: **288,471**

[22] Filed: **Aug. 10, 1994**

[30] **Foreign Application Priority Data**

Aug. 11, 1993 [DE] Germany 43 26 927.3

[51] **Int. Cl.**[6] **B41F 13/24**

[52] **U.S. Cl.** **101/232**; 271/97; 271/98

[58] **Field of Search** 101/232, 248, 101/216; 271/227, 236, 250, 11, 96, 97, 98, 20

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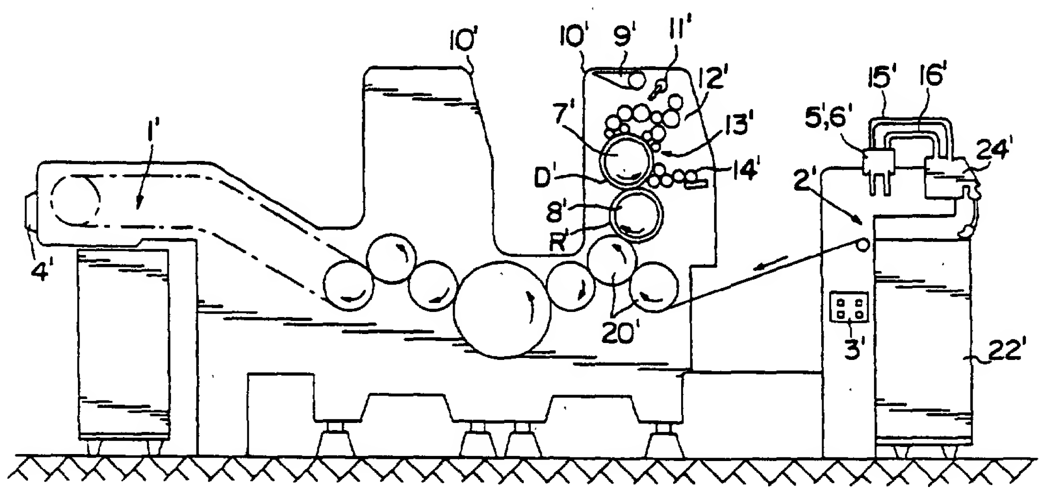
Primary Examiner—Eugene H. Eickholt
Attorney, Agent, or Firm—Nils H. Ljungman & Associates

[57] **ABSTRACT**

A printing press for printing an image on sheets of printing stock can generally have a sheet feeder for separating and at least initiating start of transport of the separated sheet into the printing press. Such a sheet feeder can have a device for controlling feeder blowing air and feeder suction air, wherein the control device can have respective valves for accurately controlling the amount of blowing air and suction air. In addition, the amount of blowing air can be essentially exactly adjustable via the control console of the machine.

20 Claims, 4 Drawing Sheets



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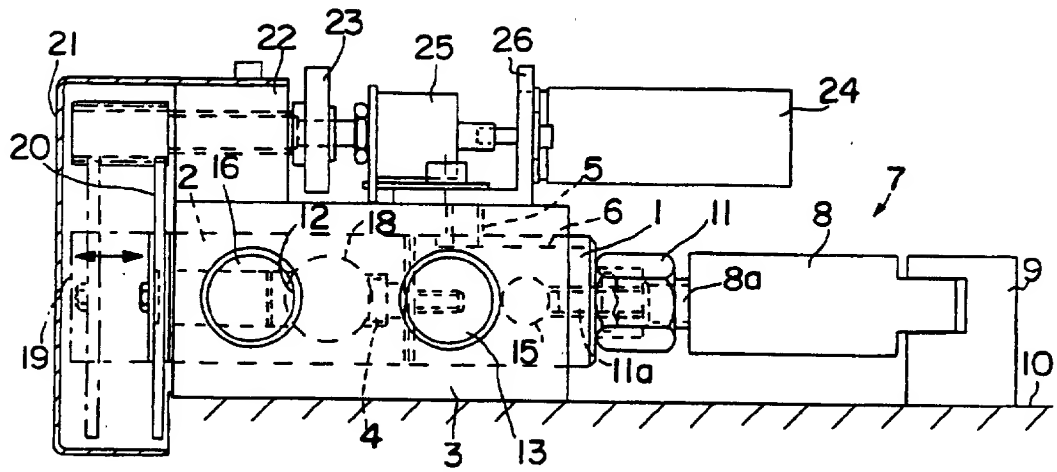
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FIG. 1

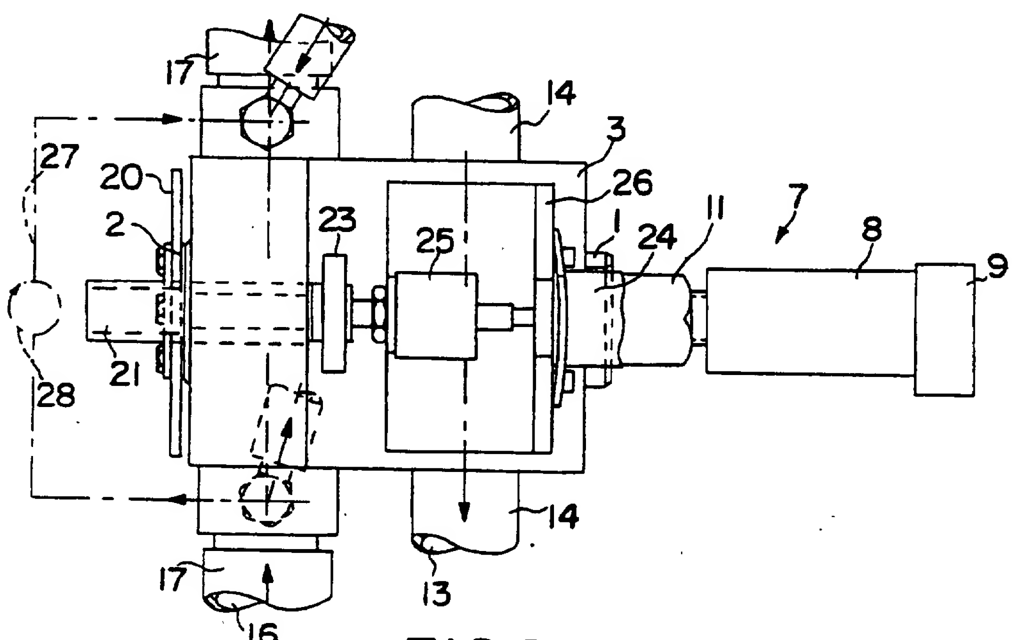
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FIG. 2

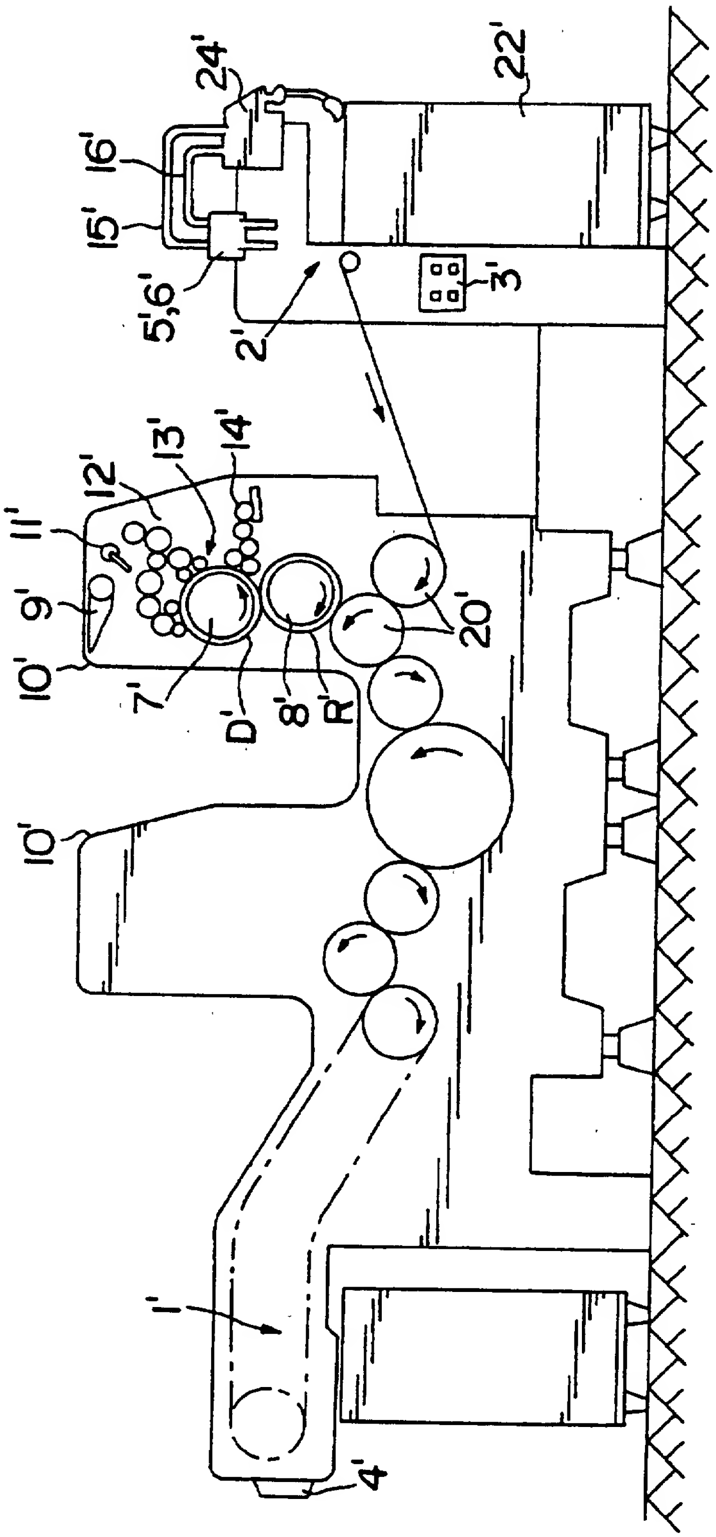

FIG.1a

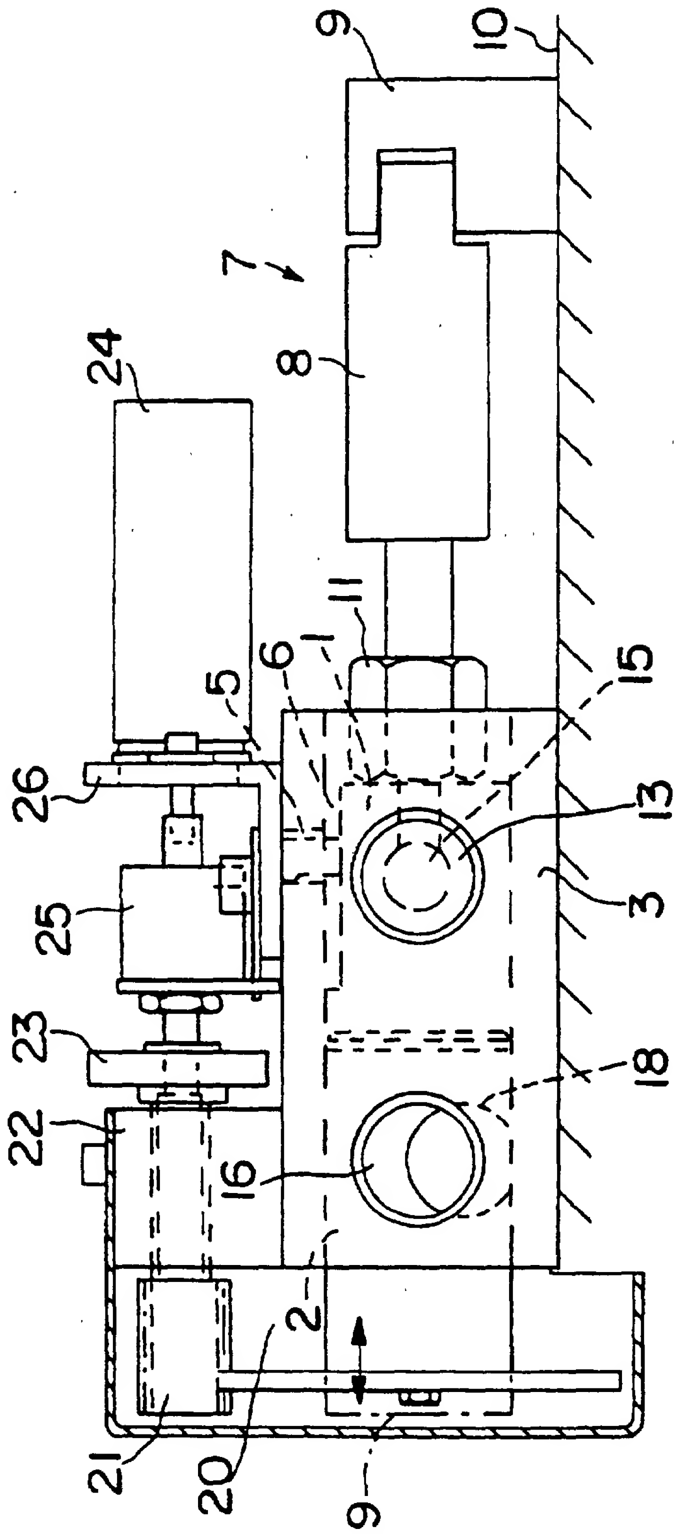

FIG.3

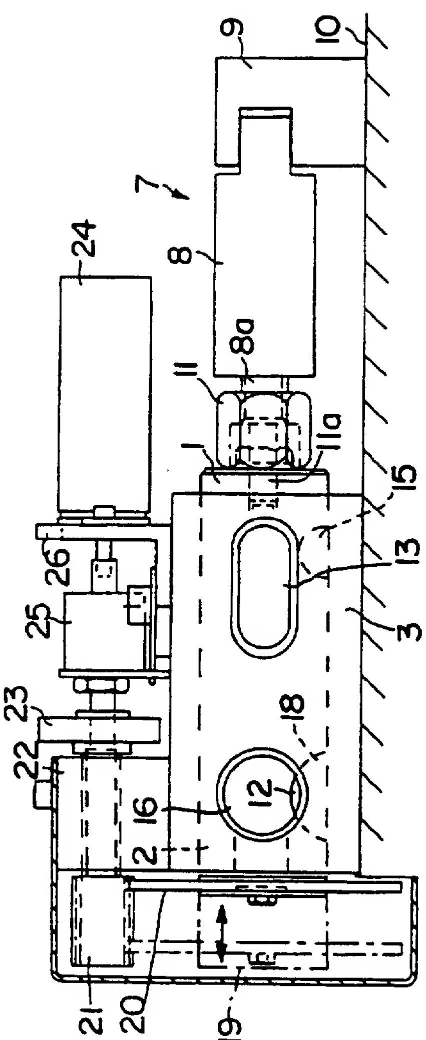

FIG.4

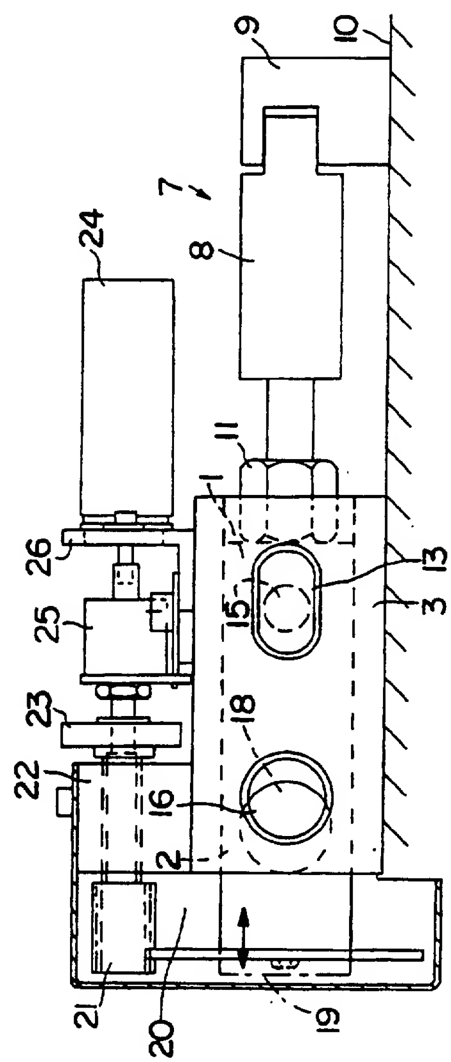

FIG.5

PRINTING PRESS HAVING A DEVICE FOR CONTROLLING THE AIR IN A SHEET FEEDER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention generally relates to a printing machine, or press having a sheet feeder, and more specifically, to a device for controlling feeder blowing air and feeder suction air in a sheet feeder of a printing machine, or press. In general, printing presses are configured to handle large quantities of sheets of printing stock supplied in the form of a stack. For this purpose, sheet feeders which utilize air currents have been developed for repeatedly separating single sheets from a stack of sheets and initiating transport of the separated single sheets into the printing press. Such sheet feeders can utilize a blowing jet of air to fan the uppermost sheets of the stack, while a suction device can be provided to then suck the uppermost sheet thereto, and also to initiate movement of the sheet attached thereto into the printing press. The air suction and supply are generally controlled by a control device, which control device generally comprises respective valves for each of the feeder and blower air.

2. Background Information

A known embodiment of such a device is disclosed by German Laid Open Patent Application No. 39 31 995 A1, which corresponds to U.S. Pat. No. 5,068,876. This known embodiment provides two separate rotary valves for controlling the air, and each valve is individually controlled via an electromagnet. With this embodiment the rotary travel of an individual valve body may be manually adjusted via a rotary-travel limiter. Furthermore, fanning air supplied to the sheet feeder can also be manually adjusted via an adjusting screw so that the pressman does not have any exact adjusting values at hand, or in other words, so that the pressman does not have to remember the adjustment values that are input through the control.

OBJECT OF THE INVENTION

Proceeding from this known device, it is the object of the present invention to provide an air-controlling device for a sheet feeder of a printing press, which air-controlling device can preferably accurately control both blowing air and suction air, and by means of which air-controlling device, the blowing-air amount may be adjusted via the control console of the printing press.

SUMMARY OF THE INVENTION

According to the present invention this object can essentially be achieved by preferably providing both a first valve body for controlling the suction air and a second valve body for controlling the blowing air in a housing so as to be axially aligned. The two valve bodies are also preferably connected to each other in a manner so as to be axially firm, or moveable essentially simultaneously in an axial direction, while still being mutually turnable with respect to one another. One manner in which such a connection can be provided can preferably be by means of a fitting bolt. Further, an adjusting means can preferably be provided for axially adjusting both valve bodies to switch the suction air and the blowing air on and off. This adjusting means can preferably act on one of the two valve bodies, and there can preferably be provided a further drive device, which, via a

pair of gears, can turn a valve body in order to control the blowing-air amount.

Such a solution essentially permits very short control periods, while enabling one adjusting means to control the suction air and the blowing air, respectively. Moreover, via the control console, the pressman may then also be able to accurately adjust the blowing-air amount for the respective sheet material which is being processed, while the blowing-air adjustment that is selected can also preferably be maintained when switching off end on the blowing air.

In an advantageous embodiment of the present invention, the valve bodies can also preferably be axially adjustable, with respect to the axial adjusting device, via an adjusting nut, to thereby allow for variations in-the size of a small opening through which the fanning air may escape when the valves are closed. Further, so that both valve bodies do not rotate when the blowing air is being adjusted, the valve body controlling the suction air can preferably be fixed against rotation by means of a pin.

A constructional modification of the above device can be provided by a device wherein the two valve bodies are firmly connected to each other, both axially and rotationally, while providing an adjusting means via which the two valve bodies can he turned in order to switch the suction air and the blowing air on and off, respectively. For this embodiment, there can preferably be provided a drive, via which the blowing-air amount can be controlled by axially displacing the valve bodies. According to this solution, given a similar setup of the valve bodies, essentially only the adjusting means is used to turn the valve bodies, and the drive serves to axially displace the valve bodies, and thus control the blowing-air amount. This exchange of adjusting means and drive means, in comparison with the first embodiment, also permits short control periods and an essentially exact adjustment of the amount off air required.

An advantageous embodiment of the two modifications described above, provides that as the adjusting means, there can preferably be provided a pneumatic cylinder for acting on the two valve bodies for controlling the suction air and the blowing air, respectively. In addition, the drive controlling the amount of blowing air can preferably be designed as a geared motor which, via a potentiometer, adjusts the second valve body. The use of a pneumatic cylinder permits very short control periods, and the use of a geared motor, in combination with a potentiometer for monitoring operation of the motor, ensures a very exact adjustment and allows for a display of the adjusted value at the control desk.

In summary, one aspect of the invention resides broadly in a printing press comprising: a frame; a plate cylinder rotatably mounted on the frame, the plate cylinder for positioning a printing plate thereon; dampening apparatus for applying dampening medium to the printing plate; an ink reservoir for holding a supply of ink; an inking mechanism for transferring the ink between the ink reservoir and the plate cylinder at least during operation of the printing press; the inking mechanism comprising a plurality of inking rollers, at least one ink fountain roller, and at least one ink transfer roller for transferring ink between the ink fountain roller and at least one of the plurality of inking rollers; sheet feeding apparatus for feeding sheets of printing stock into the printing press from a stack of printing stock, the stack having a top for supplying sheets therefrom; a rubber blanket cylinder having a rubber blanket disposed thereabout for receiving an ink impression from the plate cylinder; a sheet drum for receiving sheets being fed for printing the ink impression of the rubber blanket onto the sheets;

sheet delivery apparatus for receiving printed sheets and stacking the printed sheets; the sheet feeding apparatus comprising: apparatus for providing input air to an area adjacent the stack of printing stock; apparatus for removal of exhaust air from an area adjacent the stack of printing stock; apparatus for controlling air flow through the apparatus for providing input air and the apparatus for removal of exhaust air; the apparatus for controlling comprising valve apparatus; the valve apparatus comprising: a first valve portion for controlling flow of air through the apparatus for providing input air, the first valve portion having at least an open configuration for passage of air therethrough and a closed configuration for blocking passage of air therethrough; a second valve portion for controlling flow of air through the apparatus for removal of exhaust air, the second valve portion having at least an open configuration for passage of air therethrough and a closed configuration for blocking passage of air therethrough; at least one solid element connecting at least a portion of i the first valve portion to at least a portion of the second valve portion for substantially simultaneously moving both of the at least a portion of the first valve portion and the at least a portion of the second valve portion between at least the open configuration and the closed configuration; and single operating apparatus for operating all of the at least a portion of the first valve portion, the at least a portion of the second valve portion and the at least one solid element substantially simultaneously.

Another aspect of the invention resides broadly in a device for controlling air flow in a sheet feeder in a printing press, the sheet feeder having apparatus for providing input air thereinto and apparatus for removal of exhaust air therefrom, the device for controlling comprising: valve apparatus for controlling air flow through the apparatus for providing input air and the apparatus for removal of exhaust air; the valve apparatus comprising: a first valve portion for controlling flow of air through the apparatus for providing input air, the first valve portion having at least an open configuration for passage of air therethrough and a closed configuration for blocking passage of air therethrough; a second valve portion for controlling flow of air through the apparatus for removal of exhaust air, the second valve portion having at least an open configuration for passage of air therethrough and a closed configuration for blocking passage of air therethrough; at least one solid element connecting at least a portion of the first valve portion to at least a portion of the second valve portion for substantially simultaneously moving both of the at least a portion of the first valve portion and the at least a portion of the second valve portion between at least the open configuration and the closed configuration; and single operating apparatus for operating all of the at least a portion of the first valve portion, the at least a portion of the second valve portion and the at least one solid element Substantially simultaneously.

BRIEF DESCRIPTION OF THE DRAWINGS

Specimen embodiments of a control device in accordance with the present invention are schematically illustrated in the accompanying drawings, in which:

FIG. 1*a* shows a side view of a printing press incorporating a device for controlling feeder blowing and suction air in accordance with the present invention;

FIG. 1 shows a side elevational view of a first embodiment of an air-controlling device in an off position;

FIG. 2 shows a plan view of the device shown in FIG. 1;

FIG. 3 shows a side elevational view of the valve of FIG. 1, but in en on position;

FIG. 4 shows a side elevational view of a second embodiment of an air-controlling device in an off position; and

FIG. 5 shows a side elevational view of the valve of FIG. 4, but in an on position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1*a* depicts a printing machine, or printing press, having a number of rotary printing stands **10'**, with a sheet delivery **1'** and a sheet feeder **2'**, which sheet feeder **2'** can employ an air control device **5'**, **6'** in accordance with the present invention, and described in further detail herebelow. In addition, a rotary print stand **10'** can also generally include: an ink supply source **9'** for containing a supply of ink, a plate cylinder **7'** for having mounted thereon a printing plate D'; an inking unit **12'** which includes ink applicator rollers **13'** for applying ink to the printing press; a vibrator roller **11'** for receiving ink from the ink supply **9'** and transferring the ink to the inking unit **12'**, a damping, or wetting unit **14'** for transferring a damping agent to the printing plate D'; a blanket cylinder **8'** carrying a rubber blanket R' for receiving an ink impression from the plate cylinder **7'**, and sheet drums **20'** for carrying a sheet of printing stock to the rubber blanket cylinder **8'** for transfer of the ink from the rubber blanket cylinder **8'** to the sheet of printing stock. Such a printing press can also have other accessory units, such as washing units, drive units, etc. which are well known and are not shown in the drawings.

The sheet feeder **2'** can preferably have a stack of sheets of printing stock **22'** and an air blower and suction device **5'**, **6' 15'**, **16'** and **24'**, for lifting and transferring single sheets into the printing press. Such an air device can generally have two valve units **5'**, **6'** with one Valve unit corresponding to each of a suction air passage **15'** and a blower passage **16'**. The valves **5'** and **6'** can preferably be controlled from an operator control panel **3'**. Besides being operable via the operator controls **3'** at the sheet feeder **2'**, the sheet feeder **2'** may also be operated from a control console **4'** located at the delivery pile **1'**.

It should be understood that the components as discussed above with relation to FIG. 1*a*, may, if appropriate, essentially be considered to be interchangeable with similar components discussed herebelow with relation to FIGS. 1–5.

As depicted in FIGS. 1–3, a first valve body **1**, of a valve unit such as unit **5'**, **6'** as discussed previously in FIG. 1*a*, can preferably be provided in a housing **3** for controlling the suction air to a sheet feeder, and a second valve body **2** can preferably be provided for controlling the blowing air. In the depicted embodiment of FIG. 1, the valve bodies **1** and **2** are shown in an off position, and are arranged so as to be displaceable to the left to move the valve bodies **1** and **2** into a corresponding open position for flow of air therethrough. FIG. 3 depicts one possible configuration of the valve bodies **1** and **2** in a corresponding on position.

Both valve bodies **1**, **2** are preferably connected to each other in an axially firm and mutually turnable manner. One type of connection devise which could be used is a fitting bolt **4**, which enables the valve body **2**, controlling the blowing air, to be turned with respect to the valve body **1**, while also enabling both valve bodies to be displaced axially substantially simultaneously. In this embodiment, the valve body **1** can preferably be fixed against rotation in the housing **3** by means of a pin **5** engaging in a longitudinal groove **6** formed in the valve body **1**. Alternatively, a pin could extend from valve body **1** to engage a slot within the

housing 3. Further, other means of holding the valve body i stationary could also conceivably be used, such as a rigid connection, to an adjusting device 7.

In the specimen embodiment shown in FIG. 1 an adjusting device 7 acts on the first valve body 1, and therefore, in essence, acts on both bodies 1 and 2 because of the axial connection 4 therebetween. The adjusting device 7 can preferably be designed as a pneumatic cylinder 8 which, via a supporting bearing 9, can be attached to a wall 10 or any surface adjacent the valve device. Again, FIG. 1 shows the cylinder 8 retracted so that the valve bodies 1 and 2 are in an off, or substantially closed position. In this closed position, by means of an adjusting nut 11, the two valve bodies 1, 2 can be axially adjusted, if necessary, so that a small opening 12 can exist for the escape of fanning air. By means of such an adjustment, the size of the opening 12 can also preferably be adjusted very accurately for different paper thicknesses, etc. to allow more or less fanning air to escape therethrough. In at least one embodiment of the present invention, this adjusting nut 11 can preferably be axially fixed to a piston rod 8a, such that rotation thereof will draw a threaded rod 11a thereinto or push the threaded rod 11a away therefrom upon rotation of the nut 11, thereby axially displacing the valve bodies 1 and 2.

FIG. 1 shows the position in which the valve bodies 1, 2 are switched off so that the piston rod 8a of the pneumatic cylinder 8 is moved to the right into its end position. In so doing, an opening 13 of a suction-air line 14, can generally be closed as the suction-air opening 15, formed in the valve body 1, is displaced to the right and thus covered by the housing 3. The opening 16 of the blowing-air line 17 can preferably be offset with respect to the blowing-air opening 18 formed in the valve body 2 such that there remains a small opening 12 through which the fanning air may escape. The position in which the valves are open is the position in which both valve bodies 1, 2 are displaced to the left according to FIG. 1, as indicated by a dash-dotted line 19 in FIG. 1, and as is also depicted by FIG. 3.

In a sheet feeder device, it is generally desirable that the blowing and suction be provided by a single blower or fan unit, such as might be indicated as 24' in FIG. 1a. In other words, the air sucked out of the feeder is also the air blown back into the feeder. By providing such a valve unit wherein the blowing and suction air lines can be turned on and off substantially simultaneously using a single operational component, in accordance with the present invention, there would essentially be minimal concern about jamming of single independently operating valves for each of the blowing and suction lines, as have been used in known valve devices. Thus, both lines will either be open, or else both will be closed. On the other hand, in known devices using two separately operating valves, one valve may open when the other remains stuck shut, and there could then possibly be no suction air available while the blowing line is operating, or, alternatively, the air which is auctioned out may not be able to pass through a blocked blowing line.

In addition to the axial displacement provided by the adjusting device 7, as discussed above, an additional operating device can preferably be provided for rotating the valve body 2 with respect to the valve body 1. For this purpose, a spur gear 20 can preferably be provided for engaging in a broader spur gear 21, fastened to the front end of the valve body 2 for controlling the blowing air. The width of the spur gear 21 can preferably be designed such that the meshing of the gears is not interrupted over the axial displacement distance of the valve bodies 1, 2. The spur gear 21 can preferably be turnably mounted in a bearing body 22 and can be manually turned via a handwheel 23. Furthermore, there can also preferably be a geared motor 24 which controls the blowing-air amount and which, vie a potentiometer 25, can drive the spur gear 21. The geared motor 24 and the potentiometer 25 can preferably be fastened to the housing 3 via an angular-shaped body 26. By turning the valve body 2 via the geared motor 24 the alignment and covering of the blowing-air opening 18, and the opening 16 of the blowing-air line 17 may be varied such that a varying amount of blowing air may escape through the valve. This makes it possible to control the blowing air as a function of speed, for example, or to vary the blowing air according to the paper weight. FIG. 3 also essentially depicts an offset between the blowing air opening 18 and the opening 16, which was provided by relatively rotating the valve body 2 with respect to the valve body 1.

It should generally be understood that other types of drive systems could also possibly be used for relatively rotating the valve bodies. Such systems might include a transmission unit, such as a chain drive, or belt drive, and could even include a motor directly mounted to the end of the valve body 2, which motor could also be mounted to a holding device to be non-rotational with respect to the valve body 2. Substitution of any of the drive devices, and adjustment devices as discussed above would typically be well within the skill of the artisan, as a wide variety of drive devices are generally well known.

An alternative variant on the above embodiment of the present invention could preferably utilize, as an adjusting device 7, an electromagnet instead of a pneumatic cylinder 8. Such an electromagnet can preferably be configured to axially displace the valve bodies 1, 2, and the configuration and operation of such an electromagnet are generally well known and therefore not discussed in any:further detail herein.

The set task may also be accomplished through another inventive construction of the valve, such as could be represented by the embodiment shown in FIGS. 4 and 5. With this specimen embodiment, the blowing air can preferably be switched on and off by turning the valve bodies 1 and 2 instead of axially displacing the valve bodies 1 and 2 as was discussed hereabove. In addition, the blowing air can then preferably be regulated by axially displacing the valve bodies 1 and 2 via an axial displacement device 7, such as, a motor-driven threaded spindle, or possibly even the pneumatic cylinder as discussed above. In this manner, an adjustable opening between blowing air opening 18 and opening 16 could still be achieved.

According to this alternative embodiment, the axial position of the valve bodies 1 and 2 can preferably remain unchanged when switching on and off the blowing air. This can essentially be accomplished by simply radially turning the valve bodies 1 and 2 so that the corresponding openings are no longer essentially aligned. In the position in which the blowing air is switched off, a small opening 12, for providing fanning air for fanning the sheets, can still be achieved in that the radial adjustment can provide such an opening. With this design the blowing-air valve may be actuated together with the suction-air valve, provided the valve bodies 1, 2 are firmly connected to each other. Alternatively, as shown in FIGS. 4 and 5, the valve bodies 1 and 2 could preferably be formed of a single body piece having two openings, or passages disposed substantially diametrically therethrough.

However, the ability for the suction opening 15 to remain unchanged when regulating the blowing air, that is, after

radially adjusting the suction opening to the on position, still has to essentially be guaranteed when an axial adjustment of the blowing air is performed. For this purpose the suction-air opening 13, formed in the housing 3, can preferably be designed as an oblong hole, or slot, in the axial direction of the housing 3, so that, in the switched-on position, the bore 15 provided in the valve body 1 is still aligned with the opening 13. This oblong opening 13 should therefore preferably be of such a length that the suction-air opening remains open in view of any axial blowing-air adjustment.

As an alternative to providing a small opening 12, as shown in FIGS. 1 and 4, in an alternative embodiment of the present invention, it is also conceivable to supply the fanning blowing air through a bypass 27 (indicated by a broken line in FIG. 2), whereby the bypass may comprise a valve 28 for adjusting the amount of air which is able to pass therethrough.

One feature of the invention resides broadly in a device for controlling feeder air and feeder suction air in a sheet feeder of a printing machine comprising respective valves, characterized in that a first valve body 1 for controlling suction air and a second valve body 2 for controlling blowing air are disposed in a housing so as to be axially aligned, that the two valve bodies 1, 2 are connected to each other by a fitting bolt 4 in an axially firm and mutually turnable manner, that an adjusting means 7, via which the two valve bodies are axially adjustable for switching on/off the suction air and blowing air, respectively, acts on a valve body 1, and that there is provided a drive 24 which, via a pair of gearwheels 20, 21, turns the valve body 2 for controlling the amount of blowing air.

Another feature of the invention resides broadly in the device characterized in that, via an adjusting nut 11, the valve bodies 1, 2 are axially adjustable in order to vary the small opening 12 for the fanning blowing air, and that the valve body 1 controlling the suction air is fixed against rotation by means of a pin 5.

Yet another feature of the invention resides broadly in the device characterized in that the two valve bodies 1, 2 are firmly connected to each other, that there is provided an adjusting means 7 via which the two valve bodies 1, 2 are turnable in order to switch on/off the suction air and the blowing air, respectively, and that there is provided a drive 24 controlling the amount of blowing air by axially displacing the valve bodies 1, 2.

Still another feature of the invention resides broadly in the device characterized in that as an adjusting means 7 there is provided a pneumatic cylinder 8 acting on the two valve bodies 1, 2 for controlling the blowing air and the suction air, respectively, and that the drive controlling the amount of blowing air is designed as a geared motor 24 which, via a potentiometer 25, adjusts the second valve body 2.

Some examples of drive devices and potentiometers which could be used in conjunction with the present invention are disclosed by the following U.S. Pat. No. 5,215,014 to Burger and Mamberer, entitled "Positioning System for Rotary Folding Jaw Cylinder Adjustment Elements in a Rotary Printing Machine"; U.S. Pat. No. 5,034,004 to Crankshaw, entitled "Infusion Pump and Drive Systems Therefor"; U.S. Pat. No. 4,932,831 to White et al., entitled "All Terain Mobile Robot"; U.S. Pat. No. 4,931,041 to Feeset, entitled "Infusion Syringe Pump"; and U.S. Pat. No. 4,931,710 to DeVara and Kenny, entitled "Servoactuator with Feedback and Method of Calibrating".

Some example of pneumatic cylinders which could be used in conjunction with the present invention are disclosed by the following U.S. Pat. No. 4,573,369 to Horn, entitled "Linear Drive"; and U.S. Pat. No. 4,414,882 to Frei, entitled "Pneumatic Drive for Switching Elements and Control Elements".

Some examples of printing presses with sheet feeders that operate with blowing and suction air, in which the present invention could be used, and/or which provide additional components and features of printing presses and sheet feeders which could be used in conjunction with the present invention, are provided by the following U.S. Pat. No. 5,290,023 to Seaski and Honkawe, entitled "Sheet Feeder for Sheet-Fed Press"; U.S. Pat. No. 5,184,813 to Schwitmky and Stiel, entitled "Separating Jet Blast Air Control Assembly"; U.S. Pat. No. 5,076,564 to Marass, entitled "Sheet Feeder"; U.S. Pat. No. 5,110,110 to Wirz and Bergmeier, entitled "Loosening Blowers for Sheet Feeders of Sheet-Fed Rotary Printing Presses"; U.S. Pat. No. 5,092,578 to Bergmeier and Zeltner, entitled "Sheet Feeder in a Sheet-Processing Machine"; and U.S. Pat. No. 4,702,469 to Jeschke and Pollich, entitled "Apparatus and Method for Aligning Sheets".

The appended drawings in their entirety, including all dimensions, proportions and/or shapes in at least one embodiment of the invention, are accurate and to scale and are hereby included by reference into this specification.

All, or substantially all, of the components and methods of the various embodiments may be used with at least one embodiment or all of the embodiments, if more than one embodiment is described herein.

All of the patents, patent applications and publications recited herein, and in the Declaration attached hereto, are hereby incorporated by reference as if set forth in their entirety herein.

The corresponding foreign patent publication applications, namely, Federal Republic of Germany Patent Application No. P 43 26 927.3, filed on Aug. 11, 1993, having inventor Ernst Czotscher, and DE-OS P 43 26 927.3 and DE-PS P 43 26 927.3, as well as their published equivalents, and other equivalents or corresponding applications, if any, in corresponding cases in the Federal Republic of Germany and elsewhere, and the references cited in any of the documents cited herein, are hereby incorporated by reference as if set forth in their entirety herein.

The details in the patents, patent applications and publications may be considered to be incorporable, at applicant's option, into the claims during prosecution as further limitations in the claims to patentably distinguish any amended claims from any applied prior art.

The invention as described hereinabove in the context of the preferred embodiments is not to be taken as limited to all of the provided details thereof, since modifications and variations thereof may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. A printing press comprising:

a frame;

a plate cylinder rotatably mounted on said frame, said plate cylinder for positioning a printing plate thereon;

dampening means for applying dampening medium to said printing plate;

an ink reservoir for holding a supply of ink;

an inking mechanism for transferring the ink between said ink reservoir and said plate cylinder at least during operation of said printing press;

said inking mechanism comprising a plurality of inking

rollers, at least one ink fountain roller, and at least one ink transfer roller for transferring ink between said ink fountain roller and at least one of said plurality of inking rollers;

sheet feeding means for feeding sheets of printing stock into the printing press from a stack of printing stock, the stack having a top for supplying sheets therefrom;

a rubber blanket cylinder i having a rubber blanket disposed thereabout for receiving an ink impression from the plate cylinder;

a sheet drum for receiving sheets being fed for printing the ink impression of the rubber blanket onto the sheets;

sheet delivery apparatus for receiving printed sheets and stacking the printed sheets;

said sheet feeding means comprising:

means for providing input air to an area adjacent the stack of printing stock, said means for providing input air comprising a first air passage for conducting input air to the area adjacent the stack of printing stock;

means for removal of exhaust air from an area adjacent the stack of printing stock, said means for removal of exhaust air comprising a second air passage for conducting exhaust air away from the area adjacent the stack of printing stock;

said first air passage being separate from and isolated from said second air passage;

means for controlling air flow through said means for providing input air and said means for removal of exhaust air;

said means for controlling comprising valve means;

said valve means comprising:

a first valve portion for controlling flow of air through said first air passage, said first valve portion having at least an open configuration for passage of air therethrough and a closed configuration for blocking passage of air therethrough;

a second valve portion for controlling flow of air through said second air passage, said second valve portion having at least an open configuration for passage of air therethrough and a closed configuration for blocking passage of air therethrough;

at least one solid element connecting at least a portion of said first valve portion to at least a portion of said second valve portion, said at least a portion of said first valve portion and said at least a portion of said second valve portion being connected by said at least one solid element for substantially simultaneous movement of both of said at least a portion of said first valve portion and said at least a portion of said second valve portion from at least the closed configuration to the open configuration for substantially simultaneous providing of air to the area adjacent the stack and removing of air from the area adjacent the stack, and for substantially simultaneously moving both of said at least a portion of said first valve portion and said at least a portion of said second valve portion from at least the open configuration to the closed configuration to substantially simultaneously stop providing of air to the area adjacent the stack and removing of air from the area adjacent the stack; and

single operating means for operating all of: said at least a portion of said first valve portion, said at least a portion of said second valve portion, and said at least one solid element, substantially simultaneously.

2. The printing press according to claim 1, wherein said valve means comprises:

a valve housing, said valve housing having first and second openings for defining at least a portion of the first air passage of said means for providing input air, and third and fourth openings for defining a second air passage of said means for removal of exhaust air;

a valve body for being disposed in said valve housing, said valve body comprising a first connecting passage for connecting said first and second openings, and a second connecting passage for connecting said third and fourth openings;

said first valve portion comprises said first and second openings and said first connecting passage;

said second valve portion comprises said third and fourth openings and said second connecting passage;

said single operating means being for moving said valve body within said valve housing to:

move said first connecting passage into at least partial alignment with said first and second openings to at least partially open said first air passage, and to substantially simultaneously move said second connecting passage into at least partial alignment with said third and fourth openings to at least partially open said second air passage; and

move said first connecting passage substantially out of alignment with said first and second openings to at least substantially close said first air passage, and to substantially simultaneously move said second connecting passage substantially out of alignment with said third and fourth openings to at least substantially close said second air passage.

3. The printing press according to claim 2, wherein:

said valve housing has an;exterior and defines a longitudinal axis;

said valve housing comprises a bore along said longitudinal axis;

said first, second, third and fourth openings being disposed through said housing from said exterior to said bore;

said valve body comprises a cylindrical body for being movably disposed within said bore;

said first and second connecting passages respectively comprise first and second bores within said cylindrical body; and

said means for operating comprises means for moving said cylindrical body within said bore to at least partially open and at least substantially close said first and second air passages.

4. The printing press according to claim 3, wherein:

said means for operating comprises first means for operating, and said first means for operating comprises one of:

means for rotating said cylindrical body within said bore; and

means for axially displacing said cylindrical body along the longitudinal axis of said bore; and

said valve means additionally comprises means for varying an amount of air flowing through said first air passage substantially independently of the amount of air flowing through said second air passage.

5. The printing press according to claim 4, wherein:

said cylindrical body defines a longitudinal axis, and said cylindrical body comprises:

a first body portion comprising said first connecting passage;

a second body portion comprising said second connecting passage, said first body portion being axially disposed with respect to said second body portion along said longitudinal axis of said cylindrical body;

said at least one solid element comprises means for rotatably connecting said first body portion to said second body portion for relative rotational movement between said first body portion and said second body portion;

said first means for operating comprises means for axially displacing said cylindrical body within said bore;

said valve means further comprises means for inhibiting rotation of said second body portion; and

said means for varying an amount of air flowing through said first air passage substantially independently of air flowing through said second air passage comprises second means for operating, said second means for operating comprises means for rotating said first body portion relative to said second body portion to move said first connecting passage relative to said first and second openings to vary an opening amount of said first air passage.

6. The printing press according to claim 5, wherein:

said valve means further comprise means for axially positioning said cylindrical body with respect to said first means for operating to partially open said first air passage with said second air passage closed;

said first and second connecting passages are each disposed substantially diametrically through said cylindrical body;

said first and second openings are disposed substantially diametrically with respect to one another on said housing;

said third and fourth openings are disposed substantially diametrically with respect to one another on said housing;

said means for rotatably connecting comprises bolt means extending from one of said first body portion and said second body portion and a threaded opening on the other of said first body portion and said second body portion to receive said bolt means therein;

said means for inhibiting rotation comprises pin means extending from one of said housing and said second body portion and slot means in the other of said housing and said second body portion for receiving said pin means therein;

said first means for operating comprises a pneumatic cylinder; and

said second means for operating comprises a motor, said motor having a rotatable shaft, and said rotatable shaft additionally comprising a transmission for transmitting rotational movement to said first body portion.

7. The printing press according to claim 6, wherein:

said pneumatic cylinder comprises a piston rod extending therefrom, said pneumatic cylinder and said piston rod defining a longitudinal axis;

said longitudinal axis of said pneumatic cylinder being disposed in alignment with said longitudinal axis of said cylindrical body;

said piston rod having a first end disposed away from said pneumatic cylinder;

said second body portion comprises a threaded member extending therefrom towards said pneumatic cylinder;

said first end of said piston rod comprises a threaded nut for engaging said threaded member of said second body portion for moving said second body portion during moving of said pneumatic cylinder;

said means for axially positioning said cylindrical body with respect to said first means for operating comprises said threaded nut and said threaded member, whereby rotation of said threaded nut axially displaces said threaded member;

said second means for operating further comprises a potentiometer driven by said rotatable shaft of said motor for measuring rotational movement/of said motor;

said rotatable shaft further comprising a handwheel for manually turning said rotatable shaft;

said transmission comprising a first gear disposed on said rotatable shaft, and a second gear disposed on said first body portion and meshing with said first gear;

said second gear being non-rotatably connected to said first body portion for movement of said first body portion with movement of said second gear; and

said means for inputting air additionally comprises an air bypass for bypassing air around said valve means when said first air passage is closed; and

said air bypass comprises an additional valve means for adjusting an amount of air bypassing said valve means.

8. The printing press according to claim 4, wherein:

said cylindrical body defines a longitudinal axis, and said cylindrical body comprises:

a one-piece integral member comprising both said first connecting passage, and said second connecting passage, said at least one solid element comprises said one-piece integral member;

said first means for operating comprises means for rotating said cylindrical body within said bore; and

said means for varying an amount of air flowing through said first air passage substantially independently of air flowing through said second air passage comprises second means for operating, said second means for operating comprises means for axially displacing said cylindrical body to move said first connecting passage relative to said first and second openings to vary an opening amount of said first air passage.

9. The printing press according to claim 8, wherein:

said first and second connecting passages are each disposed substantially diametrically through said cylindrical body and said first and second connecting passages are disposed spaced apart axially along said cylindrical body;

said first and second openings are disposed substantially diametrically with respect to one another on said housing;

said third and fourth openings are disposed substantially diametrically with respect to one another on said housing;

said first means for operating comprises a motor, said motor having a rotatable shaft, and said rotatable shaft additionally comprising a transmission for transmitting rotational movement to said first body portion; and

said second means for operating comprises a pneumatic cylinder.

10. The printing press according to claim 9, wherein:

said third and fourth openings comprise oblong slots, the oblong slots having a longitudinal dimension, and the longitudinal dimension being disposed parallel to the

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longitudinal axis of said housing, said oblong slots being configured for maintaining said second air passage substantially open during axial movement of said cylindrical body to adjust air flow through said first air passage;

said pneumatic cylinder comprises a piston rod extending therefrom, said pneumatic cylinder and said piston rod defining a longitudinal axis;

said longitudinal axis of said pneumatic cylinder being disposed in alignment with said longitudinal axis of said cylindrical body;

said piston rod having a first end disposed away from said pneumatic cylinder;

said first end of said piston rod comprises means for engaging said cylindrical body for moving said cylindrical body during moving of said pneumatic cylinder;

said first means for operating further comprises a potentiometer driven by said rotatable shaft of said motor for measuring rotational movement of said motor;

said printing press further comprises at least one remote control panel for operating said first and second means for operating and monitoring said potentiometer;

said rotatable shaft further comprising a handwheel for manually turning said rotatable shaft;

said transmission comprises a first gear disposed on said rotatable shaft, and a second gear disposed on said first body portion, said second gear meshing with said first gear;

said second gear being non-rotatably connected to said cylindrical body for moving said first body portion during moving of said second gear;

said means for inputting air additionally comprises an air bypass for bypassing air around said valve means when said first air passage is closed; and

said air bypass comprises an additional valve means for adjusting an amount of air bypassing said valve means.

11. In a printing press comprising:

a frame, a plate cylinder rotatably mounted on said frame, said plate cylinder for positioning a printing plate thereon, dampening means for applying dampening medium to said printing plate, an ink reservoir for holding a supply of ink, an inking mechanism for transferring the ink between said ink reservoir and said plate cylinder at least during operation of said printing press, said inking mechanism comprising a plurality of inking rollers, at least one ink fountain roller, and at least one ink transfer roller for transferring ink between said ink fountain roller and at least one of said plurality of inking rollers, sheet feeding means for feeding sheets of printing stock into the printing press from a stack of printing stock, the stack having a top for supplying sheets therefrom, a rubber blanket cylinder having a rubber blanket disposed thereabout for receiving an ink impression from the plate cylinder, a sheet drum for receiving sheets being fed for printing the ink impression of the rubber blanket onto the sheets, and sheet delivery apparatus for receiving printed sheets and stacking the printed sheets;

means for controlling air flow of the sheet feeding means, the sheet feeding means having means for providing input air thereinto and means for removal of exhaust air therefrom, said means for controlling comprising:

valve means for controlling air flow through said means for providing input air and said means for removal of exhaust air;

said valve means comprising:

a first valve portion for controlling flow of air through said means for providing input air, said first valve portion having at least an open configuration for passage of air therethrough and a closed configuration for blocking passage of air therethrough;

a second valve portion for controlling flow of air through said means for removal of exhaust air, said second valve portion having at least an open configuration for passage of air therethrough and a closed configuration for passage of air therethrough;

at least one solid element connecting at least a portion of said first valve portion to at least a portion of said second valve portion for substantially simultaneously moving both of said at least a portion of said first valve portion and said at least a portion of said second valve portion between at least the open configuration and the closed configuration;

single operating means for operating all of said at least a portion of said first valve portion, said at least a portion of said second valve portion and said at least one solid element substantially simultaneously to substantially simultaneously open both said first and second valve portion and substantially simultaneously close said first and second valve portion; and

means for operating said first valve portion substantially independently of said second valve portion for varying an amount of air flowing through said first valve portion substantially independently of the amount of air flowing through said second valve portion.

12. The means for controlling according to claim 11, wherein said valve means comprises:

a valve housing having first and second openings for defining a first air passage of said means for providing input air, and third and fourth openings for defining a second air passage of said means for removal of exhaust air;

a valve body for being disposed in said valve housing, said valve body comprising a first connecting passage for connecting said first and second openings, and a second connecting passage for connecting said third and fourth openings;

said first valve portion comprises said first and second openings and said first connecting passage;

said second valve portion comprises said third and fourth openings and said second connecting passage;

said single operating means being for moving said valve body within said valve housing to:

move said first connecting passage into at least partial alignment with said first and second openings to at least partially open said first air passage, and to substantially simultaneously move said second connecting passage into at least partial alignment with said third and fourth openings to at least partially open said second air passage; and

move said first connecting passage substantially out of alignment with said first and second openings to at least substantially close said first air passage, and to substantially simultaneously move said second connecting passage substantially out of alignment with said third and fourth openings to at least substantially close said second air passage.

13. The means for controlling according to claim 12, wherein:

said valve housing has an exterior and defines a longitudinal axis;

said valve housing comprises a bore along said longitudinal axis;

said first, second, third and fourth openings being disposed through said housing from said exterior to said bore;

said valve body comprises a cylindrical body for being movably disposed within said bore;

said first and second connecting passages respectively comprise first and second bores within said cylindrical body; and

said means for operating comprises means for moving said cylindrical body within said bore to at least partially open and at least substantially close said first and second air passages.

14. The means for controlling according to claim 13, wherein:

said means for operating comprises first means for operating, and said first means for operating comprises one of:

means for rotating said cylindrical body within said bore; and

means for axially displacing said cylindrical body along the longitudinal axis of said bore.

15. The means for controlling according to claim 14, wherein:

said cylindrical body defines a longitudinal axis, and said cylindrical body comprises:

a first body portion comprising said first connecting passage;

a second body portion comprising said second connecting passage, said first body portion being axially disposed with respect to said second body portion along said longitudinal axis of said cylindrical body;

said at least one solid element comprises means for rotatably connecting said first body portion to said second body portion for relative rotational movement between said first body portion and said second body portion;

said first means for operating comprises means for axially displacing said cylindrical body within said bore;

said valve means further comprises means for inhibiting rotation of said second body portion; and

said means for operating said first valve portion substantially independently of said second valve portion for varying an amount of air flowing through said first air passage substantially independently of air flowing through said second air passage comprises second means for operating, said second means for operating comprises means for rotating said first body portion relative to said second body portion to move said first connecting passage relative to said first and second openings to vary an opening amount of said first air passage.

16. The means for controlling according to claim 15, wherein:

said valve means further comprise means for axially positioning said cylindrical body with respect to said first means for operating to partially open said first air passage with said second air passage closed;

said first and second connecting passages are each disposed substantially diametrically through said cylindrical body;

said first and second openings are disposed substantially diametrically with respect to one another on said housing;

said third and fourth openings are disposed substantially diametrically with respect to one another on said housing;

said means for rotatably connecting comprises bolt means extending from one of said first body portion and said second body portion end a threaded opening on the other of said first body portion and said second body portion to receive said bolt means therein;

said means for inhibiting rotation comprises pin means extending from one of said housing and said second body portion and slot means in the other of said housing and said second body portion for receiving said pin means therein;

said first means for, operating comprises a pneumatic cylinder; and

said second means for operating comprises a motor, said motor having a rotatable shaft, and said rotatable shaft additionally comprising a transmission for transmitting rotational movement to said first body portion.

17. The means for controlling according to claim 16, wherein:

said pneumatic cylinder comprises a piston rod extending therefrom, said pneumatic cylinder and said piston rod defining a longitudinal axis;

said longitudinal axis of said pneumatic cylinder being disposed in alignment with said longitudinal axis of said cylindrical body;

said piston rod having a first end disposed away from said pneumatic cylinder;

said second body portion comprises a threaded member extending therefrom towards said pneumatic cylinder;

said first end of said piston rod comprises a threaded nut for engaging said threaded member of said second body portion for moving said second body portion during moving of said pneumatic cylinder;

said means for axially positioning said cylindrical body with respect to said first means for operating comprises said threaded nut and said threaded member, whereby rotation of said threaded nut axially displaces said threaded member;

said second means for operating further comprises a potentiometer driven by said rotatable shaft of said motor for measuring rotational movement of said motor;

said rotatable shaft further comprising a handwheel for manually turning said rotatable shaft;

said transmission comprising a first gear disposed on said rotatable shaft, and a second gear disposed on said first body portion and meshing with said first gear;

said second gear being non-rotatably connected to said first body portion for movement of said first body portion with movement of said second gear; and

said means for inputting air additionally comprises an air bypass for bypassing air around said valve means when said first air passage is closed; and

said air bypass comprises an additional valve means for adjusting an amount of air bypassing said valve means.

18. The means for controlling according to claim 14, wherein:

said cylindrical body defines a longitudinal axis, and said cylindrical body comprises:

a one-piece integral member comprising both said first connecting passage, and said second connecting passage, said

at least one solid element comprises said one-piece integral member;

said first means for operating comprises means for rotating said cylindrical body within said bore; and

said means for operating said first valve portion substantially independently of said second valve portion for varying an amount of air flowing through said first air passage substantially independently of air flowing through said second air passage comprises second means for operating, said second means for operating comprises means for axially displacing said cylindrical body to move said first connecting passage relative to said first and second openings to vary an opening amount of said first air passage.

19. The means for controlling according to claim **18**, wherein:

said first and second connecting passages are each disposed substantially diametrically through said cylindrical body and said first and second connecting passages are disposed spaced apart axially along said cylindrical body;

said first and second openings are disposed substantially diametrically with respect to one another on said housing;

said third and fourth openings are disposed substantially diametrically with respect to one another on said housing;

said first means for operating comprises a motor, said motor having a rotatable shaft, and said rotatable shaft additionally comprising a transmission for transmitting rotational movement to said first body portion; and

said second means for operating comprises a pneumatic cylinder.

20. The means for controlling according to claim **19**, wherein:

said third and fourth openings comprise oblong slots, the oblong slots having a longitudinal dimension, and the longitudinal dimension being disposed parallel to the longitudinal axis of said housing, said oblong slots being configured for maintaining said second air passage substantially open during axial movement of said cylindrical body to adjust air flow through said first air passage;

said pneumatic cylinder comprises a piston rod extending therefrom, said pneumatic cylinder and said piston rod defining a longitudinal axis;

said longitudinal axis of said pneumatic cylinder being disposed in alignment with said longitudinal axis of said cylindrical body;

said piston rod having a first end disposed away from said pneumatic cylinder;

said first end of said piston rod comprises means for engaging said cylindrical body for moving said cylindrical body during moving of said pneumatic cylinder;

said first means for operating further comprises a potentiometer driven by said rotatable shaft of said motor for measuring rotational movement of said motor;

said printing press further comprises et least one remote control panel for operating said first and second means for operating and monitoring said potentiometer;

said rotatable shaft further comprising a handwheel for manually turning said rotatable shaft;

said transmission comprises a first gear disposed on said rotatable shaft, and a second gear disposed on said first body portion, said second gear meshing with said first gear;

said second gear being non-rotatably connected to said cylindrical body for moving said first body portion during moving of said second gear;

said means for inputting air additionally comprises an air bypass for bypassing air around said valve means when said first air passage is closed; and

said air bypass comprises an additional valve means for adjusting an amount of air bypassing said valve means.

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IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

PRINTING RESEARCH, INC. HOWARD W. DEMOORE and RONALD M. RENDLEMAN,	§	
Plaintiffs,	§	
v.	§	**CIVIL ACTION NO. 3-99CV1154-M**
WILLIAMSON PRINTING CORPORATION, BILL L. DAVIS and JESSE S. WILLIAMSON,	§	
Defendants.	§	

EXPERT REPORT OF RAYMOND
<u>J. PRINCE UNDER FEDERAL RULE 26(a)(2)(B)</u>

1. I make this report based upon my knowledge as to the factual matters set forth below and upon my own opinions as to matters set forth as such. This report relates to litigation between the above referenced parties. My involvement is as a "technical expert" on lithographic and flexographic processes, presses and components thereof and trends in the printing arts; plus retraction devices therefor. For consulting work I charge $1,350/day ($168.75/hr), including trial plus expenses. If called as a witness in this case, I would testify as follows:

I.
MY EDUCATION AND WORK EXPERIENCE

2. Reference is made to a detailed resume of my education and work experience, etc. current to the date of this report, and is presented herein in its entirety as an attachment, my *curriculum vitae*, Exhibit "A" hereto. I am senior technical consultant in the Technical Services Group at the Graphic Arts Technical Foundation (GATF) in Pittsburgh, Pennsylvania. I

presently consult with about thirty (30) companies, of which Williamson Printing Corporation ("WPC") is one. I travel extensively throughout North America to consult with my clients, who are generally commercial printers, packaging printers, label printers, magazine printers, wine label printers, and book printers. I teach printing courses for GATF and for Rochester Institute of Technology, as well as for Printing Industries of America ("PIA") affiliates and for most of the graphic arts trade shows.

3. I received an Associates degree and a Bachelor of Science degree from Rochester Institute of Technology in 1963 and 1965, respectively. I received a Masters of Science in Printing Management from South Dakota State University in 1966. I have won a number of medals, including a medal this year from the National Association for Printing Leadership ("NAPL") – the Soderstrom Medal for Lifetime Achievement Award. I have also won in 1992 from NAPL the Craftsman of the Year Award, 1994 from GATF, the Industry Education Award, and in 1998 the Technical Association for the Graphic Arts ("TAGA") Honors Award for Lifetime Achievement.

4. I have written a number of articles and books, set forth in Exhibit "B" hereto.

5. I have not consulted in any other litigation in the past five years.

6. I have been asked the following questions:

(a) What was the state of the art as of mid-1992 to mid-1994 with respect to the use of flexography in lithographic presses?

(b) What was the state of the art from May 1992 - June 1994 with respect to

(1) Retractable coaters?

(2) Anilox rollers?

(3) Chambered doctors?

(c) Did WPC provide sufficient information to PRI in mid June, 1994 (Baker, Baker Supp., Bird, Bird Suppl., Bird 2d Suppl. Declarations) for a person of ordinary skill in the art of making auxiliary printing equipment to make an interstation flexo unit for use in the flexo/litho process of the '363 patent? If not, was it sufficient by the end of 1994 after transmission of additional information to Bird (See Bird Suppl. Decl., ¶¶ 3-5)?

(d) With respect to PRI's developmental drawings of Interstation printer/coater options

(1) linear rack back (disclosed in their drawing of 12/5/94), and

(2) cantilevered device (12/5/94 and 12/30/94)

were these drawings, alone, sufficient to teach one of ordinary skill at that time of the '363 process? If not, did any of the December PRI drawings do so, alone or in combination?

(e) Does application Serial No. 08/435,798, as filed, enable one of ordinary skill to practice the '363 process?

(f) Did Bill Davis and Jesse Williamson have a conception in June 1992 - which I understand is a concept so complete and well defined that it could be reduced to practice when told to one of ordinary skill in the art and without undue experimentation?

(g) Did the concept of Davis and Williamson as described by them to Bowyer in 1992 and subsequently to Baker and Bird in 1994 embrace the retractable flexo unit shown in Fig. 2 of the '363 patent?

(h) Was the flexographic/lithograhic process described in the '363 patent an advance in the art? A significant advance? What is the relationship between the WIMS '976 patent ("WIMS I") and the '363 process ("WIMS II")?

(i) Do any of the claims of Serial No. 08/435,798 as originally filed, cover Davis and Williamson's process?

(j) Do any of the claims of Serial No. 08/435,798 as originally filed, cover the device of Fig. 2 of the '363 patent?

(k) Do any of the claims of Serial No. 08/435,798 as those claims exist now before the PTO cover the Davis and Williamson process?

(l) Do any of the pending claims of Serial No. 08/435,798 cover the apparatus of Fig. 2? If so, are those claims within the prior art?

(m) Was the EZI device actually installed at Williamson an advance in the art?

(n) Is the subject matter of any of the allowed claims of Serial No. 08/435,798 beyond the level of skill in the art as of May 1995?

(o) Has WPC won any awards in the printing arts for creativity?

(p) How does WPC rank in technology in the printing arts versus other printers?

(q) What is Printing Research, Inc.'s ("PRI") reputation in the industry?

(r) Has PRI won any awards?

(s) How does PRI rank in technology in research and development versus other printing research institutions?

(t) Are any of the claims of U.S. Patents 5,960,713 and 6,116,158 supported by the disclosure in Serial No. 08/435/798?

7. In reaching the conclusions set forth herein, I have reviewed:

Bucket	Descriptions	Bates Nos.
A	PRI's Drawings;	Various
B	U.S. Patent No. 5,370,976 to Williamson, et al.; U.S. Patent No. 5,630,363 to Davis, et al.;	PRI01055-PRI01062, W000010-W000017
C	U.S. Patent No. 5,638,752 to Hartung, et al. and 5,476,042 to Ehrhard et al.;	W012899-W012913
D	Declarations - master List (all declarations submitted in reissue application, including those of reissue applicants and Ray Prince, and third party witnesses Baker, Bird, Garner and Brown, etc.);	W012914-W013389
E	Paper submitted October 13, 2000 to PTO entitled REISSUE APPLICANTS FIRST SUBMISSION OF DEPOSITION TESTIMONY AND SUBMISSION OF SUPPLEMENTAL DECLARATION, including Depositions of Baker, Bird, Brown and Garner and exhibits and recent (October 5, 2000) Supplemental Declarations of Baker and Bird; and recently submitted expert reports of Pravel and Professor Mott;	W013390-W014323
F	Pleadings by the parties in this case, including proposed counterclaims of Defendants;	W014325-W014398
G	Plaintiffs' and Defendants' responses to interrogatories, requests for admissions and document requests;	W014399-W014496
H	The expert reports of Pravel and Professor Mott as tabbed in"E" above;	W014497-W014526
I	Various copies of Serial No. 08/435,798, as filed May 5, 1995 and a counterpart EP0741025(A3);	W01349-W01409; W014527-W014595
J	U.S. Patent No. 5,598,777, U.S. Patent No. 5,651,777, U.S. Patent No. 5,960,713 (Ray Prince studied this in detail and testified about the '713 in the PTO); U.S. Patent No. 6,116,158;	W014596-W014699
K	Original Reissue Application as filed 5-20-99, including original cut-up specification and proposed claims;	W014701-W014768

Bucket	Descriptions	Bates Nos.
L	PTO Protest of DeMoore, et al., in PTO reissue, September 1999;	W014769-W014771
M	First Office Action in PTO reissue mailed February 9, 2000;	W014772-W014786
N	Amended and Cut-up Specification and Reissue Applicants' Position on Patentability with Attached Declarations of Baker, Bird, Brown, Bird supplement, and Garner filed April 7, 2000;	W014787-W015270
O	Supplemental amendment filed July 7, 2000 in the reissue application;	W015271-W015475
P	First supplemental statement of prior art and other information filed May 20, 1999 (original set of prior art);	W015476-W015801
Q	Second supplemental statement of prior art and other information filed July 17, 2000 (art not previously included and mentioned in Item "N" above and abroad and in Serial No. 08/435,798;	W015802-W016603
R	Third supplemental statement of prior art and other information filed September 26, 2000 (the Hartung, et al. patent Item "C" above and Declaration including Ray Prince's Third Supplemental Declaration);	W016604-W016616
S	Fourth supplemental statement of prior art and other information filed September 29, 2000 (including Canadian brochure and Ray Prince's Fourth Supplemental Declaration);	W016617-W017040
T	Deposition of Bill Davis (not concluded);	W017041-W017230 and exhibits of other numbered series
U	Deposition of Ron Rendleman (not concluded);	W017231-W017552 and exhibits of other numbered series
V	Deposition of Jesse Williamson (not concluded);	W017553-W017775 and exhibits of other numbered series
W	Deposition of Howard DeMoore (not concluded);	W017776-W018097 and exhibits of other numbered series

Bucket	Descriptions	Bates Nos.
X	File History EP 620,115 (counterpart to U.S. Patent 5,638,752) and English translations of European applications; KVA Opposition and decision and prior art K1-K7 cited by Opponents	W018098-W018865
Y	Prior Art to Exhibit 2	W018867-W019721
Z	Selected portions of File History, U.S. Patent 5,960,713	W02038-W02663
AA	File History, Serial No. 08/435,798	W01670-W02034

8. With respect to the questions in paragraph 6, I have the following responses:

(a) As of mid-1992, the industry had little, if any, use of flexography in lithographic presses. The lithographic and flexographic printing processes were generally not used together at that time, and were performed by different tradesmen on radically different types of machinery. I recall MAN-Roland introduced its 700 series having a coater end-of-press in September 1993 at the IPEX Exhibition at Manchester, England. By mid-1994, Heidelberg Drucksmaschusen A.G. started experiments in Germany with the construction of press with an end-of-press anilox roller. In this time frame, rapid advancements were being made in the resolution of flexographic plates and printing, but still the flexographic and lithographic arts were operated by different tradesmen. The first marriages of flexographic to lithographic with respect to lithographic presses were strictly end-of-press applications. Flexographic plate technology (resolution and stability of a small dot) was improving from mid-1992 to mid-1994.

(b) Retractable coaters in this time period were used primarily in the folding carton industry to apply water-based protective coating. The primary reasons for a retractable coater were that tower coaters were expensive, and generally not available. A tower coater at this time, as a practical matter, could not be retrofit to an existing press. Auxiliary coaters were made for a particular model of a press of a known manufacturer, and varied in at least seven know designs, of which a great number of patents and brochures existed in the early 1990s. A number of vendors existed in the United States

making auxiliary retractable coaters: Dahlgren, Rapidac, Epic, Oxy-Dry and others. Perhaps as many as five hundred or more of auxiliary retractable machines existed in the United States. Dahlgren was the leader in the field. There was a controversy in the industry with respect to how to best coat a water-based or UV-based coating. Both anilox and smooth roller systems existed side-by-side. For water-based coatings in the folding carton industry, the roller of choice was anilox due to consistency of volume. In the commercial printing industry, the system of choice was the smooth roller to provide very high gloss. The chambered doctor came about and had been used in non-press applications for the primary reason of consistency in coating weight. After WPC had achieved its proprietary '976 WIMS technology, it was faced with a problem of getting a large pigment particle size to the sheet of paper. From his 37 C.F.R. §1.131 declaration (executed June 3, 2000, W012997-13005), and his subsequent declaration signed September 22, 2000 (W013263-13279), I understand Jesse Williamson, while in Germany in late May 1992, thought about using flexography with a chambered doctor blade for the sole purpose of applying a thick, consistent coating ink to a printing plate. Use of the chambered doctor blade was a viable way to apply a thick consistent pigmented coating. Dahlgren had started to use it in its end-of-press auxiliary coaters, principally using the DiRico patented technology. I have participated as an expert in the reissue application to U.S. Patent 5,630,363, Serial No. 09/315,796, and agree with Davis and Williamson's comments about the prior art in their Reissue Applicants' Memorandum Concerning the Prior Art and Position of Patentability (W014812E-AA) filed on April 7, 2000. Reissue Applicants' Second Supplemental Statement of Prior Art and Other Information (W015802-16603) provides a fairly comprehensive list of the prior art, both patent and industry literature. There were a variety of prior art auxiliary systems used as of mid-1994: inclined, horizontal, vertical, transverse, ferris, four-bar and combined (Note also prior art binders (W018866-19721)). In my opinion, as of 1994 DiRico, Bird, Dahlgren, Satterwhite, were leaders in the auxiliary equipment art.

(c) The answer to this question is a resounding yes. The information of going "up front", why it was important to WPC do so, and the various possibilities of accomplishing same and the preferred way Davis and Williamson wanted their process accomplished was transmitted on June 12, 1994 to a trained salesman - Baker (W013251-13255) - having a background in printing since his formative years and a degree in printing according to his deposition testimony. I cannot imagine how Jesse Williamson and Bill Davis could have been more explicit. They provided the reasons for doing their process and a roadmap of how it was to be accomplished. It is my opinion that, armed with this information, any one of a number of U.S. auxiliary retractable equipment manufacturers could have built the unit in 1994-5, needing only the model of the press and taking dimensions. Baker clearly understood what was needed and desired. He told Bird (declaration, W013256-13262). Given the information, Bird could deliver the client's wishes to DeMoore, and he testified he did so on June 15, 1994 (W013246 at 13247). Bird was told additional process details starting on August 18, 1994 in a series of meetings (¶¶3-4 of Bird Supplemental Declaration, W013193-W013245). There is no doubt in my mind - and it is my opinion -- that Dahlgren, Epic or Rapidac could have come up with the blueprints and fabricated the appropriate auxiliary equipment in 120, if not 90, days, and at that time (mid to late 1994), under $75,000 each for three units. Installation would be done in a time frame of less than a week. It is clear from his declaration and deposition testimony that Brown of Heidelberg understood what was needed, and started helping Davis investigate plate making equipment.

(d) I have looked at bucket "A", the PRI drawings. The early December 1994 drawings do not clearly specify an anilox roller or the application of flexographic inks, nor do they even specify the ability to do a spot coating to the blanket. One skilled in the art in December-January 1994 might have presumed that the drawings pertained to a flood coater. Many of the drawings show contact of the contemplated auxiliary unit to the plate cylinder, with no detailed description of what the anilox roller would comprise. Even the drawings in February 1995 show coaters at the last unit or the last

coating tower in end-of-press applications, with no detail as to the type of special anilox rollers to engage the plate cylinder. Left out of these February 1995 drawings is the drying unit between the two towers. The drawings provided by PRI do not disclose the Davis/Williamson '363 process. A number of drawings apparently show in handwriting comments that Rendleman or DeMoore gave their lawyers since the beginning of this lawsuit. I have visited WPC and studied the PRI auxiliary equipment actually installed at WPC. I would be hard-pressed to see how one of ordinary skill could build and install any of these auxiliary pieces from the December 1994 - March 1995 drawings, as the equipment actually exists.

(e) I studied Serial No. 08/435,798 during the prosecution of the reissue to U.S. Patent 5,630,363 and incorporated my comments in paragraph 11 to my Supplemental Declaration signed March 15, 2000. Serial No. 08/435,798 did not at that time enable one of ordinary skill in the art to make a workable device consistent with the teaching of the '798 application, let alone enable one to practice the '363 process. The teachings are confusing because the applicants are trying to teach too many things. There are too many options. The options to the plate and the "double bump" are not credible. Why would someone want to contact the plate cylinder? More research would have had to be taught on the "resilient anilox roller" and the relative advantages of the "double bump" concept. The first interstation ferris wheel devices made by PRI which were sold to WPC only contacted the blanket cylinder. It is my opinion that one of ordinary skill in the art reading the PRI application on May 4, 1995 would have been greatly confused by it. The '798 application does not teach the apparati on the WPC presses.

(f) The answer is yes. Minor experimentation was needed, but not undue. I have read the Joint Declaration (1) Under 37 C.F.R. §1.131 and (2) Pertaining to Derivation by DeMoore and Printing Research, Inc. of Reissue Applicants' Invention (W012997-13047 and Exhibits), Declaration of Jesse Speight Williamson (W013262-13279), Declaration of Harry Bowyer (W013287-13311) and Declaration of Gary Doughty (W013312-13328). One of ordinary skill in coating technology and printing technology working for a manufacturer of equipment that specializes in coaters as well as press

auxiliary equipment would have been able to reduce the Davis/Williamson concept to practice (see ¶8, Williamson Declaration at W013265). I note also ¶4 of the Bowyer Declaration (W013288), which indicates Bowyer understood what Williamson and Davis meant by the three options of performing the Davis/Williamson process.

(g) The '363 patent Fig. 2 embraces a retractable auxiliary unit having an anilox roller and a chambered doctor. The particular geometry – the "ferris wheel" concept – was one of several different geometries already known in the art. Such a geometry is not material to the operation of the '363 process.

(h) The method disclosed in the '363 patent was most assuredly an important advance in the art – the answer is a resounding yes. It allowed for a larger pigment size to be placed on the substrate, thereby increasing brilliance. I believe U.S. Patent No. 5,370,976 ("'976") WIMS I teaches the process of producing integrated metallic separations in detail and the process of printing with them. The Davis/Williamson '363 patent teaches an improvement to that process – the use of flexography instead of lithography for the printing of gold and silver. Absent a prior knowledge of WIMS I ('976), there would be little or no reason for one skilled in the art to try the process disclosed in the '363 patent. The advance in brilliance of depositing gold and silvers is equally matched by the in-line continuous process advance, which made the process of the '363 patent much more economical than a process requiring two or more passes.

(i) The answer is no. Only claims 24-34 are method claims. Claims 24 and 30 are the only independent method claims. Claim 24 pertains to spot coating and does not require the application of flexographic inks – literally any ink could be used. Use of an anilox roller is not mentioned. Claim 30 is not the'363 process: in a two-stage press, one takes a printing plate and one performs spot printing. There is no requirement of using the flexographic inks. There is no requirement of using an anilox roller.

(j) In my opinion, if at all, perhaps Claim 17 can relate to '363 Fig. 2, although many necessary appropriate limitations are missing, e.g., flexographic inks, and an anilox roller for application of flexographic inks.

(k) I have read the prosecution through the summer of 2000 for Serial No. 08/435,798. Exhibit C hereto contains what is represented to me as the pending claims, including 5 allowed claims. The answer to the question is no. There are no process claims.

(l) Possibly Claim 17, if at all. Claim 1 is a "double bump" apparatus – not Fig. 2 of the '363 patent. For Claims 12 and 13, I do not read "plate or blanket" as pertaining to Fig. 2, and many of the additional critical limitations are missing. Claim 17 is "loose" and has many critical limitations missing. Limitations involving flexographic inks and an anilox roller are missing. There are some clerical errors in this claim as pending. I am giving PRI the benefit of the doubt.

(m) The '363 process is an advance. Apart from the process, the unit from my observation does have some smart features – it does not intrude on the basic Heidelberg press. On the other hand, it is my opinion it is an "$\propto$" version (i.e., first generation) and needs a larger diameter anilox roller. The units at WPC have had "bouncing" problems. The ferris wheel concept – which is old in the art – is a good concept, but the execution of Davis and Williamson's design by PRI should be improved. I observed the PRI auxiliary equipment at WPC, and it utilized parts all existing as of 1994.

(n) The answer is no. Allowed claims 6 and 9 have extra features, all of which are in the prior art and were obvious to employ: e.g., power actuators, bell cranks, cleavis plates, doctor blades. Reference to options such as "plate or blanket" limitation is inoperable as taught in the specification. Claim 18 has a "double cradle" limitation and is drawn to an inoperably described embodiment ("double bump"). Claim 19 describes a tower coater adaption of an end-of-press auxiliary unit. Claim 21 has the same "end-of-press" tower coater at Claim 19. None of the five allowed claims

describe Fig. 2 of the '363 patent. The bulk of the rejected claims were rejected on Bird taken in view of Sarda. That rejection is proper. Other references could have been substituted for each of Bird and Sarda.

(o) Awards are given for the printing of individual pieces. WPC has hundreds, if not a thousand awards for individual pieces for print quality and visual appeal, both at the local and national level. For the last three years, WPC has been rated as number one in this country. They have halls lined with prizes.

(p) WPC is, in my opinion, one of the very top (top 10) of leading commercial printers in the United States. The equipment in pre-press and press is state-of-the-art.

(q) Printing Research has a good reputation due to its Super Blue™ and BacVac™ products. It is a reputation of vigorously defending its patent position.

(r) Printing Research has won one – and only one award from GATF (Intertech Award) – in the mid-1980s for its SuperBlue technology.

(s) In the perception of the printing industry, PRI ranks below each of Dahlgren and Epic in the auxiliary coater market. They have a better reputation in IR drying than UV drying. To this day, PRI is really known as a "one-horse" shop – its SuperBlue product. I have reviewed the patents assigned to PRI (W002867-W03583). Very few of these patents appear to me to be commercial. U.S. Pat. 4,402,267 was the "SuperBlue" patent. U.S. Pat. 4,691,267 also perhaps pertains to "SuperBlue". U.S. Pat. 5,127,329 pertains to the "BacVac" as perhaps do some of the downstream U.S. Pats. 5,133,255; 5,205,217; 5,243,909; 5,419,254 and 5,488,905, which are all related applications. U.S. Pat. 5,335,596 perhaps pertains to a commercial chambered doctor. U.S. Pat. 5,425,809 may be commercial. U.S. Pat. 5,511,480 is the "SuperBlue II" patent. U.S. Pats. 5,603,264; 6,073,556; and 6,119,597 are other "SuperBlue II" patents and may be pertinent. U.S. Pat. 5,966,836 may pertain to a commercial IR dryer, as does U.S. Pat. 6,088,931. Most of the patents appear to be "paper patents". Apart from "SuperBlue" and "BacVac", DeMoore does not have a reputation in the industry as a major inventor.

(t) None of the claims of DeMoore, et al. U.S. Pats. 5,960,713 and 6,116,158 have any support in Ser. No. 08/435,798. Note my Second Supplemental Declaration of Raymond J. Prince executed June 29, 2000, ¶¶8-14 concerning the '713 patent. The '158 patent claims have largely the same problems.

9. The opinions given herein are based solely on the testimony and other documents listed in paragraph 7 above, and the undersigned reserves the right to change, to alter, or to enhance his testimony upon the review of additional testimony or other documents.

Raymond J. Prince

Dated: November 15, 2000

CERTIFICATE OF SERVICE

I hereby certify that the foregoing Expert Report of Raymond J. Prince under Federal Rule 26(a)(2)(b) was served on Plaintiffs' counsel by placing a true and correct copy thereof in the United States Mail, postage prepaid, on the 17 day of November, 2000, addressed as follows:

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